# CHAPTER 5

## Histochemical localization of lipids in the gonadal and extra-gonadal tissues in seasonally reproducing birds.

The reproductive cycle of birds is marked by a significant histophysiological alteration in terms of gametogenesis and steroidogenesis. Cyclic distinguishing steroidogenic changes in gonadal and extra-gonadal tissues were observed in the two species of Mynas studied, Bank Myna (*Acridotheres ginginianus*) and Brahminy Myna (*Sturnus pagodarum*), in relation with the pre-breeding, breeding, post-breeding and non-breeding phases as discussed in the previous chapters (Chapters 1, 2 and 3). The histochemical profiles of the gonadal and extra- gonadal tissues have provided an evidence for the steroidogenic status of extra-gonadal tissues in male and female seasonally reproducing birds. In this light, histochemical localization and the concurrent alterations in various components of lipid can also be made use to understand the variations in gonadal and extra-gonadal status of the seasonally breeding birds.

Both lipids and steroid-dehydrogenases are usually known to show inverse relationship between them (Johnson, 1970; Kotak, 1979; Dorrington, 1977). Higher content of lipid and lower activity levels of the steroid dehydrogenase are characteristic of steroidogenically inactive gonads and the reverse set of changes being characteristic of active gonad.

Lipids are a rich source of energy reserves. It has been noted that the capability of birds for storing triglycerides as energy reserves exceeds that of other classes of vertebrates (Blem, 1976). Apart from the metabolic significance, lipids especially cholesterol positive lipids form the raw materials for steroidogenesis (Nalbandov, 1970). Lofts and Murton (1973) have reported that the cyclic waxing and waning of cellular lipids, which though in itself is insignificant to implicate unequivocally a steroid synthesizing role, is a useful index of the functional activity of the gonadal tissue.

## Results :

### Pre-breeding :

Among the different parts of ovaries, in Bank Myna, the theca interna layer showed moderate localization of neutral lipids [Plate XXV (a)] and phospholipids [Plate XXV (c)] with Fettrot-7B and Nile Blue Sulphate respectively. Total lipids stained with Sudan Black B were high [Plate XXV (b)]. The granulosa layer showed high neutral lipid content and moderate total and phospholipids whereas intense neutral as well as total lipids were observed in the interstitial cells with no phospholipids accumulation (Table: 9). An altogether different pattern of distribution of total lipid was observed in the Brahminy Myna (Table: 10). The theca interna showed intense localization of total lipids [Plate XXV (e)] while that of neutral [Plate XXV (d)] and phospholipids [Plate XXV (f)] was moderate. In the granulosa layer, the intensity was moderate with Fettrot-7B, high with Sudan Black B and little with Nile Blue Sulphate whereas the interstitial cells had intense total lipids with Sudan Black B, moderate neutral lipids with Fettrot-7B and mild phospholipids with Nile Blue Sulphate (Table: 9)[Plate XXV (d, e, f)].

In the extra-gonadal tissues also prominent differences in the pattern of lipid accumulations were observed. The pre-breeding liver showed little neutral lipid localization [Plate XXVI (a, d)] but, high total lipid content [Plate XXVI (b, e)] and moderate phospholipid [Plate XXVI (c, f)] localization in both the Bank Myna and Brahminy Myna females. Intestine, the major route of absorptive pathway also showed moderate changes in the neutral fats and phospholipid localization in both the species of Brahminy Mynas. In the intestine only the villar epithelium and intestinal glands showed varied accumulation of different components of lipids studied throughout the reproductive cycle. During the pre-breeding season, the epithelium of villi was the main site for lipid accumulation (Table: 9&10) with little neutral lipid concentration in Bank Myna females [Plate XXVII (a)]. In the Brahminy Myna females, [Plate XXVII (d)] the epithelium of villi showed little neutral fats with other areas of the intestine showing mild distribution of neutral fats. The intensity of total lipids was highest (intense level) in the epithelium of villi in the Bank Myna females [Plate XXVII (b)], but in the Brahminy Myna female though it was highest, the accumulation was at 'high' level [Plate XXVII (e)]. Phospholipid accumulation was high in the epithelium of villi and the intestinal glands [Plate XXVII (c, f)] in both the female Mynas. The Bank myna females and the Brahminy Myna females, showed similar type of distribution pattern in the nephric tubules, the glomeruli and the medullary region (Table: 9&10). With Fettrot-7B, the nephric tubules showed mild accumulation of neutral lipids [Plate XXVIII (a, d)] whereas the glomeruli of nephric tubules and medulla of the kidneys of both the female Mynas had no neutral lipid content. In the Bank Myna females, total lipid accumulation was high in the nephric tubules, little in the glomeruli and mild in medullary region [Plate XXVIII (b)] and in the Brahminy Myna females, the nephric tubules showed moderate, glomeruli had mild and medullary region showed

little distribution of total lipids [Plate XXVIII (e)]. With Nile Blue Sulphate, the phospholipid accumulation was little in the nephric tubules and medulla while in the glomeruli it was mild in both the female Mynas [Plate XXVIII (c, f)].

Both the species of male Mynas showed varying intensities of lipid localization in the seminiferous tubule and the interstitial cells of the testes (Table: 11&12). In the Bank Mynas, intense neutral fat localization was noted in the seminiferous tubules and moderate localization in the interstitial cells [Plate XXIX (a)]. Moderate total lipids with Sudan Black B in the seminiferous tubules and the interstitial cells [Plate XXIX (b)] and moderate phospholipids in the seminiferous tubules and intense localization in the interstitial cells [Plate XXIX (c)] were noted. The pre-breeding testes of Brahminy Mynas showed moderate neutral lipid [Plate XXIX (d)] and total lipid [Plate XXIX (e)] localization in the seminiferous tubules and little localization of both the lipids in the interstitial cells. Phospholipid accumulation with Nile Blue Sulphate was *vice versa*; it was moderate in the interstitial cells and little in the seminiferous tubules [Plate XXIX (f)].

The lipid accumulation in the hepatocytes between the two species of male Mynas showed little variation (Table: 11&12). In the Bank Myna males, the liver showed little neutral lipid localization [Plate XXX (a)] and high total lipid [Plate XXX (b)] and phospholipid accumulation [Plate XXX (c)] but in the Brahminy Myna males, the liver showed mild neutral lipid localization [Plate XXX (d)] and moderate distribution of total [Plate XXX (e)] and phospholipids [Plate XXX (f)]. In the intestine, (Table: 11&12), the epithelium of villi in the Bank Myna and the Brahminy Myna males, showed little neutral lipid content while the intestinal glands showed mild accumulation of neutral lipids [Plate XXXI (a, d)]. In Bank Myna males, the epithelium of villi [Plate XXXI (b)] showed moderate total lipid accumulation and the intestinal

glands showed little accumulation where as in the Brahminy Myna males, the sudanophilic lipids were high in both the intestinal glands and the epithelium of villi [Plate XXXI (e)]. In both the species, phospholipids were elevated in the epithelium of villi and intensely stained in the intestinal glands [Plate XXXI (c, f)]. The nephric tubules showed little neutral and total fat deposition and the glomeruli had mild deposition of both these lipids [Plate XXXII (a, b, d, e)] in both the male Mynas and the phospholipid accumulation was little all over the kidney *i.e.,* in the medulla, nephric tubules and the glomeruli [Plate XXXII(c, f)] (Table: 11&12).

Breeding Season:

During the breeding months of May/June /July, (Table: 9&10), the neutral lipid localization in the interstitial cells was intense in both the female Mynas but the theca interna showed moderate neutral lipid localization and granulosa had intense neutral fats in Bank Myna [Plate XXXIII (a)] females, whereas in the Brahminy Myna females in both the theca interna and granulosa layer, neutral fat contents were high [Plate XXXIII (d)]. The total lipid accumulation was intense in the theca interna, granulosa and the interstitial cells of ovaries in Bank Myna [Plate XXXIII (b)] and Brahminy Myna [Plate XXXIII (e)]. In the Bank Myna females, phospholipids accumulation was high in all the three areas of the ovary *i.e.*, the theca interna, granulosa and the interstitial cells [Plate XXXIII(c)] whereas in the Brahminy Mynas, it was little in these areas [Plate XXXIII (f)].

The hepatocytes showed little neutral lipids in the female individuals of both the Mynas [Plate XXXIV (a, d)](Table: 9&10). Total lipid accumulation was moderate in the Bank Myna females [Plate XXXIV (b)] and high in the Brahminy Myna females [Plate XXXIV (e)]. The phospholipids localization was mild in the Bank Myna females

[Plate XXXIV (c)] and little in the Brahminy Myna females [Plate XXXIV (f)]. Coming to the intestine, (Table: 9 and 10) in the Bank Myna females, the neutral fat accumulation was mild in intestinal glands, epithelium of villi and the corium of villi [Plate XXXV (a)] and in the Brahminy Myna females, the intestinal glands and the corium of villi showed mild intensity with the epithelium of villi having little neutral lipids [Plate XXXV (d)]. The total fats with Sudan Black B in the intestine of both the female Mynas showed only marginal differences. The epithelium of villi had high total lipid localization in Bank Myna females [Plate XXXV (b)] and moderate in the Brahminy Myna females [Plate XXXV (e)]. The other areas of the intestine showed mild total lipid accumulation. Phospholipid localization was high in the epithelium of villi and the intestinal glands and the corium of villi in the intestine of both the female Mynas during the breeding season [Plate XXXV (c, f)]. In the kidneys, localization of lipid components also showed slight variations in the nephric tubules and glomeruli of the two female Mynas (Table: 9 & 10). The glomerular neutral lipid accumulation was mild in both the female Mynas but the nephric tubules showed little neutral fat accumulation in the Bank Myna females [Plate XXXVI (a)] and mild in the Brahminy Myna females [Plate XXXVI (d)]. The total lipid distribution in the nephric tubules was moderate and in the glomeruli, it was little in both the Bank Myna and Brahminy Myna females [Plate XXXVI (b, e)]. The phospholipid content in glomeruli was almost negligible in both the female Mynas [Plate XXXVI (c, f)].

Neutral lipids were present only in the germinal cells of seminiferous tubules during the breeding season, which was mild in both the Mynas [Plate XXXVII (a, d)] (Table: 11&12). Total lipids [Plate XXXVII (b, e)] and phospholipids [Plate XXXVII (c, f)] were present in the whole of seminiferous tubules with moderate and high distribution respectively. The interstitial cells had mild intensity of

neutral lipids, little of total lipids in both the Mynas whereas the phospholipid contents were high in Bank Myna males and intense in Brahminy Myna males (Table: 11&12).

The hepatocytes showed little accumulation of all the three lipids in Bank Myna males [Plate XXXVIII (a, b, c)] whereas in the other species neutral lipids and phospholipid contents were little and total lipid accumulation was moderate [Plate XXXVIII (d, e, f)] (Table: 11&12). The neutral and total lipid distribution in different parts of the intestine in Bank Myna males [Plate XXXIX (a, b, c)] was almost similar to that observed in Bank Myna females except that of phospholipids which was moderately distributed in the intestinal glands in the male birds (Table: 9, 10, 11 & 12). In the other species, a difference was observed in neutral lipid distribution of epithelium of villi where it was little in Brahminy Myna [Plate XXXIX (d)] and nil in Bank Myna.

When the males of the two species were compared, a converse pattern of phospholipid localization was observed. In the Bank Myna males, phospholipids were moderately localized in the intestinal glands [Plate XXXIX (c)] whereas, in the Brahminy Myna males, their accumulation was high [Plate XXXIX (f)]. The epithelium of villi had high localization of phospholipids in the Bank Myna males and moderate in the Brahminy Myna males. A similar pattern of all the three lipid component was observed in the nephric tubules of males of both the Mynas (Table: 11&12) with no neutral fats in medulla and mild in the nephric tubules and glomeruli, little total lipids in medulla and glomeruli; moderate in the nephric tubules and finally mild distribution of phospholipids in the nephric tissues and glomeruli [Plate XXXX (a, b, c, d, e, f)].

Post-Breeding Season:

High neutral and total lipid accumulation still persisted only in the interstitial cells of the ovaries of the Bank Myna [Plate XXXXI (a, b)] and Brahminy Myna [Plate XXXXI (d, e)]. The theca interna showed mild distribution of neutral lipids in Bank Myna ovaries and it was nil in the Brahminy Myna ovaries. In the granulosa layer, the neutral lipid localization was high in the Bank Myna and moderate in the Brahminy Myna and in the interstitial cells, the neutral lipid localization was intense in both the Mynas (Table: 9&10). A discernible difference to that of previous season was observed in the total lipid localization in the theca interna of both the Mynas [Plate XXXXI (b, e)]. In the Bank Mynas, the total lipid accumulation was high whereas in the Brahminy Mynas it was little. In the granulosa layer also, a difference in the sudanophilic lipids was observed; it was intense in the Bank Myna but high in the Brahminy Myna. Only the interstitial cells showed similar localization pattern, which was intense in both the Mynas. The phospholipid localization was nil in the theca interna and mild in the granulosa layer and interstitial cells in the Bank Myna [Plate XXXXI (c)] whereas in the Brahminy Myna [Plate XXXXI (f)] it was moderate throughout the different layers of the ovary.

Neutral and total fat accumulation during the post-breeding months in the hepatocytes of both the female Mynas showed similar distribution pattern (Table: 9&10). Neutral lipids were moderately localised whereas total lipid accumulation was high in both the female Mynas [Plate XXXXII (a, b, d, e)]. Phospholipid accumulation in hepatocytes was intense in the Bank Myna females [Plate XXXXII (c)] and little in the Brahminy Myna females [Plate XXXXII (f)]. In the intestine a decrease in the neutral fat localization was seen during the post-breeding season when compared to the breeding season (Table: 9&10). There was mild localization of neutral lipids only in the

epithelium of villi; the other areas of intestine had negligible neutral lipid localization in both the female Mynas [Plate XXXXIII (a, d)]. High total lipid accumulation in the epithelium of villi in the Bank Myna females [Plate XXXXIII (b)] and moderate accumulation in the Brahminy Myna females [Plate XXXXIII (e)] was observed during this season. A difference in the phospholipid accumulation in both the female Mynas was observed with the epithelium of villi and intestinal glands having high phospholipid accumulation in the Bank Myna female and comparatively less in the Brahminy Myna females [Plate XXXXIII (c, g)]. Mild neutral lipid accumulations were observed in the nephric tubules as well as the glomeruli of the kidneys in both the female Mynas [Plate XXXXIV (a, d)] whereas the sudanophilic lipid localization was moderate in the nephric tubules and little in the glomeruli [Plate XXXXIV (b, e)]. Phospholipids were mild in both nephric tubules and glomeruli in both the female Mynas during the post-breeding season [Plate XXXXIV (c, f)].

The post-breeding testes of the Bank Mynas and the Brahminy Mynas showed a significant difference in the lipid localization patterns. The germinal epithelial cells of the seminiferous tubules showed mild neutral lipids and total lipids in the Bank Mynas [Plate XXXXV (a, b)] and moderate neutral and total lipids in the Brahminy Mynas [Plate XXXXV (d, e)]. The interstitial cells showed little accumulation of neutral fats and moderate accumulation of total lipids in the Bank Myna testes whereas it was mild in the Brahminy Myna testes. The phospholipid accumulation was moderate in the seminiferous tubules and intense in the interstitial cells of testes of both the Mynas [Plate XXXXV (c, f)].

In the hepatocytes of the Bank Myna and the Brahminy Myna males, the neutral lipid localization was little and total lipid was moderate whereas, the phospholipid localization was low in both the

male Mynas [Plate XXXXVI (a, b, c, d, e, f)]. The intestinal glands showed mild neutral lipid localization and it was moderate in the epithelium of villi in both the male Mynas [Plate XXXXVII (a, d)]. However, the sudanophilic lipids were high in the epithelium of villi and little in the intestinal glands of both the male Mynas [Plate XXXXVII (b, e)]. Phospholipid accumulation was high in the intestinal glands and moderate in the epithelium of villi in both the male Mynas [Plate XXXXVII (c, f)]. In the kidneys, neutral lipid accumulation was mild in the nephric tubules as well as glomeruli, total lipid contents were moderate in the nephric tubules and mild in the glomeruli [Plate XXXXVIII (a, b, d, e)] and phospholipid accumulation was low in the nephric tubules and negligible in the glomeruli of both the male Mynas [Plate XXXXVIII (c, f)].

Non-Breeding Season :

In the ovaries of the Bank Myna negligible neutral lipid accumulation was observed in the theca interna, granulosa layer and the interstitial cells during the non-breeding months [Plate XXXXIX (a)] whereas in the Brahminy Mynas neutral fats accumulation was nil in the theca interna, moderate in the granulosa layer and high in the interstitial cells [Plate XXXXIX (d)]. Yolk filled small ovulatory follicles in the Bank Myna ovaries, which were intensely stained with Sudan Black B was a noticeable characteristic of the non-breeding ovary [Plate XXXXIX (b)]. However, sudanophilic lipids were moderately accumulated in the granulosa layer and intense in the interstitial cells of the Bank Mynas. In the Brahminy Mynas, the granulosa layer showed high localization of sudanophilic lipids whereas in the interstitial cells the total lipid localization was intense [Plate XXXXIX (e)]. The accumulation of phospholipids was little in the granulosa layer and the interstitial cells in the Bank Myna [Plate XXXXIX (c)] whereas it was

mild in both the granulosa layer and interstitial cells in the Brahminy Myna ovaries [Plate XXXXIX (f)]. No phospholipids were observed in the theca interna of both the Bank Myna and the Brahminy Myna (Table: 9&10).

The hepatocytes of both Bank Myna and Brahminy Myna females showed little neutral lipid accumulation [Plate L (a, d)] whereas the total lipid accumulation was high [Plate L (b, e)]. Phospholipids were intense in the hepatocytes of female Bank Mynas [Plate L (c)] and moderate in the female Brahminy Mynas [Plate L (f)]. In the intestine, only the epithelium of villi showed little neutral lipid in the two species of female Mynas [Plate LI (a, d)]. High sudanophilic lipids were observed in the epithelium of villi in both the female Mynas but very little localization of total lipids was observed in the intestinal glands [Plate LI (b, e)]. Phospholipid accumulation was intense in the intestinal glands and high in the epithelium of villi in the Bank Myna female [Plate LI (c)] whereas in the Brahminy Myna females, the localization was little in both the above-mentioned areas of the intestine [Plate LI (f)]. Neutral lipid accumulation was mild in the medulla, nephric tubules and the glomeruli of the Bank Myna females [Plate LII (a)] whereas in the Brahminy Myna female mild neutral lipid localization was observed only in the nephric tubules [Plate LII (d)]. The sudanophilic lipid accumulation was little in medulla and nephric tubules and mild in the glomeruli of both the female Mynas [Plate LII (b, e)] and phospholipid accumulation was mild in all the three regions of the kidneys [Plate LII (c, f)](Table: 9&10).

A striking difference was observed in the lipid localization of testes between the two species of Mynas studied (Table: 11&12). The seminiferous tubules and the interstitial cells of non-breeding testes of Bank Myna showed no neutral lipid accumulation and the total lipid and phospholipids localization was mild [Plate LIII (a, b, c)]. In the

Brahminy Mynas, the neutral and total lipids were moderately localized in the seminiferous tubules and mild in the interstitial cells and, phospholipids were high in both these regions [Plate LIII (d, e, f)].

In the male Mynas, during the non-breeding season, the lipid accumulation was little in the hepatocytes with all the three stains: Fettrot-7B, Sudan Black B and Nile Blue Sulphate (Table: 11&12)[Plate LIV (a, b, c, d, e, f)]. The intestine showed moderate neutral lipids in the epithelium of villi and little in the intestinal glands [Plate LV (a, d)]. Almost identical pattern of neutral and total lipid accumulation in the intestine was observed in both the species of male Mynas (Table: 11& 12) only variation being in the intestinal glands in the Bank Mynas where the phospholipid accumulation was intense and in the Brahminy Myna males, it was high phospholipid accumulation. The epithelium of villi showed high phospholipid accumulation in Bank Myna and in the Brahminy Myna moderate localization of phospholipids were observed [Plate LV (c, f)]. In the kidneys of male Mynas also, similar trend of neutral, total and phospholipids were observed (Table: 11&12). Here, neutral lipids were mild as observed in the three earlier phases [Plate LVI (a, e)]. The medulla and the nephric tubules had little total and phospholipid content and the glomeruli had mild total and phospholipid localization [Plate LVI (b, c, d, f)].

## Discussion :

Neutral lipids are stored as lipid droplets and are bounded by specific proteins and phospholipids. Lipid bodies arise from micro domains of the endoplasmic reticulum that contain lipid-biosynthesizing enzymes, and their synthesis and size appear to be controlled by specific protein components (Murphy and Vance, 1999). Three major interconnected pathways are involved in lipoprotein metabolism: (1) the

transport of dietary or exogenous fat, (2) the transport of hepatic or endogenous fat and (3) cholesterol transport (Kwiterovich, 2000). Taking into account these considerations, the results observed in the gonadal and extra-gonadal tissues of Bank Myna and the Brahminy Myna can be discussed as follows:

When the localization of lipids in the extra-gonadal tissues of the male and female birds were compared it has been observed that the lipid accumulation was higher in the female birds than in the males (Table: 9, 10, 11 & 12). The probable reason for this kind of difference in lipid accumulation pattern in the male and female birds can be related to the variations in physiological activities. The chores of preparation for the breeding cycle, egg-laying, taking care of the young ones and the post- breeding activities require huge amounts of energy supplements. Lipids form the major source of energy supplement. Lipids are synthesized in the liver and transported *via* blood mainly to the adipose tissue; the liver under such conditions is likely to show adaptive changes involving enhanced functional activities of certain enzymes (Gilbert *et al.*, 1975). In the Bank Myna and the Brahminy Myna females, the neutral fat localization in the liver was little in the pre-breeding [Plate XXVI (a, d)], breeding [Plate XXXIV (a, d)] and non-breeding months [Plate L (a, d)] and it was moderate only in the post-breeding months [Plate XXXXVI (a, d)]. The presences of high concentration of neutral fats have been demonstrated in a large number of specialized cells of liver in fowl, Mynas, crow, bulbul and babbler (Pilo *et al.*, 1973a).

It is known that high lipid diet increases the neutral fat content (triglycerides) in the liver. In addition, most of the lipids taken up by the liver are oxidized or converted into lipoproteins and sent to adipose tissue through blood. The excess of any metabolite in the blood stream is taken up by the liver either to be oxidized or to be converted into

storage products. This explanation could be given to the presence of high total lipids in liver of both the sexes of Mynas during the four phases of reproductive cycle [Plate XXVI, XXX, XXXIV, XXXVIII, XXXXII, XXXXVI, L, LIV (b, e)]. Similar results of high concentration of fats in liver of some passeriformes due to increased consumption of fatty diet have been put forth (Pilo *et al.,* 1973b). These workers further state that lipase was active in the parenchymal cells of the liver in birds (carnivores, insectivores, omnivores, frugivores and graminivores), suggesting that avian liver has a prominent role in lipid metabolism whether the diet contains large quantity of fat or not. Quantitative and histochemical studies on fat in liver of White Wagtails (*Motacila alba*) and Yellow Wagtails (*Motacila flava*) have shown that there is a considerable increase of lipids during the migratory phase *i.e.*, April/May, than during the winter months of September and October (John and George, 1965). The reason for the decrease may be attributed to shorter feeding hours during winter and higher energy requirements (Naik, 1963).

Lipids or fatty acids that are synthesized in the liver are transported to the ovary for their deposition in the follicles (Mc Indoe, 1971). This fact is evident in the lipid localization in the ovaries [Plate XXV and XXXIII (a, b, c, d, e, f)] and liver [Plate XXVI and XXXIV (a, b, c, d, e, f)] of the Bank Myna and the Brahminy Myna females during pre-breeding and breeding phases (Table: 9 & 10). Similar distribution pattern of lipids (neutral fats, total lipids and phospholipids) were observed in the Purple Sunbird, *Nectarina asiatica*, (Asnani *et al.*, 1973).

Phospholipids, the complex lipids that yield glycerol, fatty acids, phosphoric acid and choline are known to appear when the neutral fats disappear (John, 1967). During the pre-breeding and the breeding months of Bank Myna females, liver showed moderate and mild

phospholipid localization respectively, and the total lipid localization was high. From this it is clear that during these two phases the lipids synthesized by the liver cells are actively liberated in the circulation and taken up by the gonadal cells in preparation for follicular development as well as gametogenesis. The post-breeding and non-breeding months in the Bank Myna females showed intense localization of phospholipids in the hepatocytes while the neutral fat content was varied from moderate to high (Table: 9&10). This phenomenon may indicate biosynthesis of phospholipids in the hepatocytes at a normal rate but absence of their mobilization or utilization leading to accumulation within the liver cells particularly in these two phases.

The intestinal glands and the epithelium of villi were the two major sites of lipid localization in the Bank Mynas and Brahminy Mynas throughout the year (Table 9&10). The neutral lipid localization with Fettrot-7B was maintained at lower level in the pre-breeding, breeding and non-breeding months and mild in the post-breeding months of both species of Mynas [Plate XXVII, XXXI, XXXV, XXXIX, XXXXIII, XXXXVII, LI, and LV (a. d)]. Sudanophilic lipid localization was intense only during the pre-breeding season of Bank Myna females and it was moderate in the Bank Myna males and in the other phases of the breeding cycle elevated localization was maintained in the epithelium of villi [Plate XXVII, XXXI, XXXV, XXXIX, XXXXIII, XXXXVII, LI, LV(b, e)]. It appears that the localization of lipids in villi and glands is not directly related to the functional relationship of liver and gonads during different phases of reproductive cycles. However, the presence of lipids in these sites is in all probability related to post-absorptive buildup of lipids in intestinal cells. Further, the lipids localized may also facilitate metabolic activities of villi and submucosal glands. Phospholipid accumulation was high in the epithelium of villi of the Bank Myna males and females, through out the four phases of the

reproductive cycle but it was variable in Brahminy Myna males and females [Plate XXVII, XXXI, XXXV, XXXIX, XXXXIII, XXXXVII, LI, LV (c, f)]. The species-specific variation in the localization of lipids in the intestinal epithelium is apparently related to variation in the feeding habits. Bank Mynas spend more time in feeding activities than the Brahminy Mynas, the latter being very choosy about its dietary choice, and dependent on availability of natural food during different seasons of breeding cycle. The brush border and the epithelial cells of villi, lamina propria and cells of the intestinal glands are the sites of absorption of lipids (Shah *et al.*, 1976a, 1976b). Animal fatty acid synthetase (FAS), an enzyme which synthesizes long-chain fatty acids have been revealed to be distributed in cells of adult human tissues, with high lipid metabolism (hepatocytes) and in the epithelial cells of duodenum and stomach *etc.* suggesting active fatty acid synthesis for energy utilization in these areas (Kusskabe *et al.*, 2000).

Fluorescence and electron microscopic studies of rat gastro duodenal and mucosal cells have shown that the mucous cells of gastric mucosa and the submucosal Brunner's Glands of the duodenum contain a sub cellular organelle that store hydrophobic material constituting both neutral lipids and phospholipids, which provide a nonwettable lining to repel luminal acid from stomach (Kao and Lichtenberger, 1987, 1990, 1991; Schmitz and Muller, 1991). The role of surface-active phospholipids in gastric cyto-protection has been demonstrated in rats in the early eighties (Lichtenberger *et al.*, 1983). In the light of the reports sighted here, it could be suggested that the lipids in these areas may have such auto protective function also.

In the kidney, neutral fat was mild in the nephric tubules of Bank Myna male and female birds during all the four phases of reproductive cycles (Table: 9, 10, 11&12) [Plate XXVIII, XXXII, XXXVI, XXXX, XXXXIV, XXXXVIII, LII, LVI (a, d)]. The sudanophilic lipids were

maintained at reasonable level during the pre-breeding, breeding and post-breeding phases of both the male and female Mynas and it decreased to little localization in the non-breeding phase [Plate XXVIII, XXXII, XXXVI, XXXX, XXXXIV, XXXXVIII, LII, LVI (b, e)]. Glomerular lipids were mild throughout the reproductive phases in the male and female birds of both the Mynas. Phospholipids were comparatively sparse in the nephric tubules and glomeruli of both the Mynas during all the four phases of the reproductive cycles [Plate XXVIII, XXXII, XXXVI, XXXX, XXXXIV, XXXXVIII, LII, LVI (c, f)]. The presence of apolipoprotein B and apoA-I almost exclusively in the epithelial cells of proximal and distal convoluted tubules have been related to the role of these tubules in chick kidneys and may contribute to the plasma lipoprotein pool (Targui *et al.*, 1998).

Taking into consideration the preceding account it can be inferred that the lipids localized in the intestine and kidneys in the present study are in all probability related to provisions mentioned in the references sighted, and not directly related to reproductive biology of birds.

## Abbreviations :

Tl = Theca Layer

G = Granulosa

Ic = Interstitial Cells

S = Stroma

ST = Seminiferous Tubule

M.Externa = Muscularis externa

T.Propria= Tunica Propria

Int. Glands=Intestinal Glands

Epi. Of Villi= Epithelium of Villi

Cor. Of Villi= Corium of Villi

Nephric T= Nephric Tubules

Glom=Glomeruli

Pr-Br = Pre-Breeding

Br = Breeding

Po-Br = Post Breeding

Non-Br = Non-breeding

## Activity Pattern :

- – : No activity
- ± : Mild activity
- + : Little activity
- ++ : Moderate activity
- +++ : High activity
- +++++ : Intense-activity

Table: 9: Histochemical distribution of lipids in gonads and extra-gonadal tissues in Bank Myna females

| Bank Myna | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Pre-Br | | | Br | | | Post-Br | | | Non-Br | | |
| Activity | F | S | NBS | F | S | NBS | F | S | NBS | F | S | NBS |
| Tissues | Ovary | | | | | | | | | | | |
| Tl | ++ | +++ | ++ | ++ | +++++ | +++ | ± | + | - | - | - | - |
| G | +++ | ++ | ++ | +++++ | +++++ | +++ | +++ | +++++ | ± | - | ++ | + |
| Ic | +++++ | +++++ | - | +++++ | +++++ | +++ | +++++ | +++++ | ± | - | +++++ | + |
| | Liver | | | | | | | | | | | |
| Hepatocytes | + | +++ | ++ | + | ++ | ± | ++ | +++ | +++++ | + | +++ | +++++ |
| | Intestine | | | | | | | | | | | |
| M. Ext | - | - | - | ± | + | - | - | ± | ± | - | ± | ± |
| T.Prop | - | - | ± | ± | + | ± | - | - | ± | - | ± | ± |
| Int. Gl | - | + | +++ | ± | + | +++ | - | ± | +++ | - | + | +++++ |
| Epi. of Villi | + | +++++ | +++ | ± | +++ | +++ | ± | +++ | +++ | + | +++ | +++ |
| Cor. of Villi | - | ++ | ± | ± | ± | ± | - | ± | ± | - | ± | + |
| | Kidney | | | | | | | | | | | |
| Medulla | - | ± | + | + | + | + | ± | + | ± | ± | + | ± |
| Neph. T | ± | +++ | + | + | ++ | + | ± | ++ | ± | ± | + | ± |
| Glom | - | + | ± | ± | + | ± | ± | + | ± | ± | ± | ± |

Table: 10: Histochemical distribution of lipids in gonads and extra-gonadal tissues in Brahminy Myna females

| Brahminy Myna | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Pre-Br | | | Br | | | Post-Br | | | Non-Br | | |
| Activity | F | S | NBS | F | S | NBS | F | S | NBS | F | S | NBS |
| Tissues | Ovary | | | | | | | | | | | |
| Tl | ++ | +++++ | ++ | +++ | +++++ | + | - | + | ++ | - | - | - |
| G | ++ | +++ | + | +++ | +++++ | + | ++ | +++ | ++ | ++ | +++ | ± |
| Ic | ++ | +++++ | ± | +++++ | +++++ | + | +++++ | +++++ | ++ | +++ | +++++ | ± |
| Liver | | | | | | | | | | | | |
| Hepatocytes | + | +++ | ++ | + | +++ | + | ++ | +++ | + | + | +++ | ++ |
| Intestine | | | | | | | | | | | | |
| M. Ext | ± | ± | ± | - | + | - | - | ± | - | - | - | ± |
| T.Prop | ± | ± | ± | - | ± | ± | - | - | - | - | - | ± |
| Int. Gl | ± | + | +++ | ± | + | +++ | - | ± | + | - | + | + |
| Epi. of Villi | + | +++ | +++ | + | ++ | +++ | ± | ++ | + | + | +++ | + |
| Cor. of Villi | ± | + | ± | ± | ± | ± | - | ± | + | - | ± | ± |
| Kidney | | | | | | | | | | | | |
| Medulla | - | + | + | ± | ± | + | ± | + | + | - | + | ± |
| Neph. T | ± | ++ | + | ± | ++ | + | ± | ++ | ± | ± | + | ± |
| Glom | - | ± | ± | ± | + | ± | ± | + | ± | - | ± | ± |

Table: 11: Histochemical distribution of lipids in gonads and extra-gonadal tissues in Bank Myna Males

| Bank Myna | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Pre-Br | | | Br | | | Post-Br | | | Non-Br | | |
| Activity | F | S | NBS | F | S | NBS | F | S | NBS | F | S | NBS |
| Tissues | Testis | | | | | | | | | | | |
| Sem.Tubule | +++++ | ++ | ++ | ± | ++ | +++ | ± | ± | ++ | - | ± | ± |
| Ic | ++ | ++ | +++++ | ± | + | +++ | + | ++ | +++++ | - | ± | ± |
| | Liver | | | | | | | | | | | |
| Hepatocytes | + | +++ | +++ | + | + | + | + | ++ | + | + | + | + |
| | Intestine | | | | | | | | | | | |
| M. Ext | - | ± | ± | - | ± | - | - | ± | ± | - | - | + |
| T.Prop | - | ± | ± | - | ± | - | - | ± | ± | - | + | ± |
| Int. Gl | ± | + | +++++ | + | ± | ++ | ± | + | +++ | + | + | +++++ |
| Epi. of Villi | + | ++ | +++ | - | ++ | +++ | ++ | +++ | ++ | ++ | +++ | +++ |
| Cor. of Villi | ± | ± | + | - | ± | + | ± | ± | ± | - | ± | + |
| | Kidney | | | | | | | | | | | |
| Medulla | - | - | + | - | + | - | + | + | ± | ± | + | + |
| Neph. T | + | + | + | ± | ++ | ± | ± | ++ | + | ± | + | + |
| Glom | ± | ± | + | ± | + | ± | ± | ± | ± | ± | ± | ± |

Table: 12: Histochemical distribution of lipids in gonads and extra-gonadal tissues in Brahminy Myna Males

| Brahminy Myna | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Pre-Br | | | Br | | | Post-Br | | | Non-Br | | |
| Activity | F | S | NBS | F | S | NBS | F | S | NBS | F | S | NBS |
| Tissues | Testis | | | | | | | | | | | |
| Sem.Tubule | ++ | ++ | + | ± | ++ | +++++ | ++ | ++ | ++ | ++ | ++ | +++ |
| Ic | + | + | ++ | ± | + | +++++ | ± | ± | +++++ | ± | ± | +++ |
| | Liver | | | | | | | | | | | |
| Hepatocytes | ± | ++ | ++ | + | ++ | + | + | ++ | ± | + | + | + |
| | Intestine | | | | | | | | | | | |
| M. Ext | - | ± | ± | - | ± | ± | - | ± | ± | - | ± | ± |
| T.Prop | - | ± | ± | - | ± | ± | - | ± | ± | - | ± | ± |
| Int. Gl | ± | +++ | +++++ | + | ± | +++ | ± | + | +++ | + | + | +++ |
| Epi. of Villi | + | +++ | +++ | + | ++ | ++ | ++ | +++ | ++ | ++ | +++ | ++ |
| Cor. of Villi | ± | + | + | - | ± | ± | ± | ± | ± | - | ± | ± |
| | Kidney | | | | | | | | | | | |
| Medulla | - | - | + | - | + | - | + | + | ± | ± | + | + |
| Neph. T | + | + | + | ± | ++ | ± | ± | ++ | + | ± | + | + |
| Glom | ± | ± | + | ± | + | ± | ± | ± | ± | ± | ± | ± |

Plate XXV

Histochemical localization of lipids in **ovaries** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
Tl : Theca Layer ; G : Granulosa ; IC : Interstitial Cells

# PLATE XXV

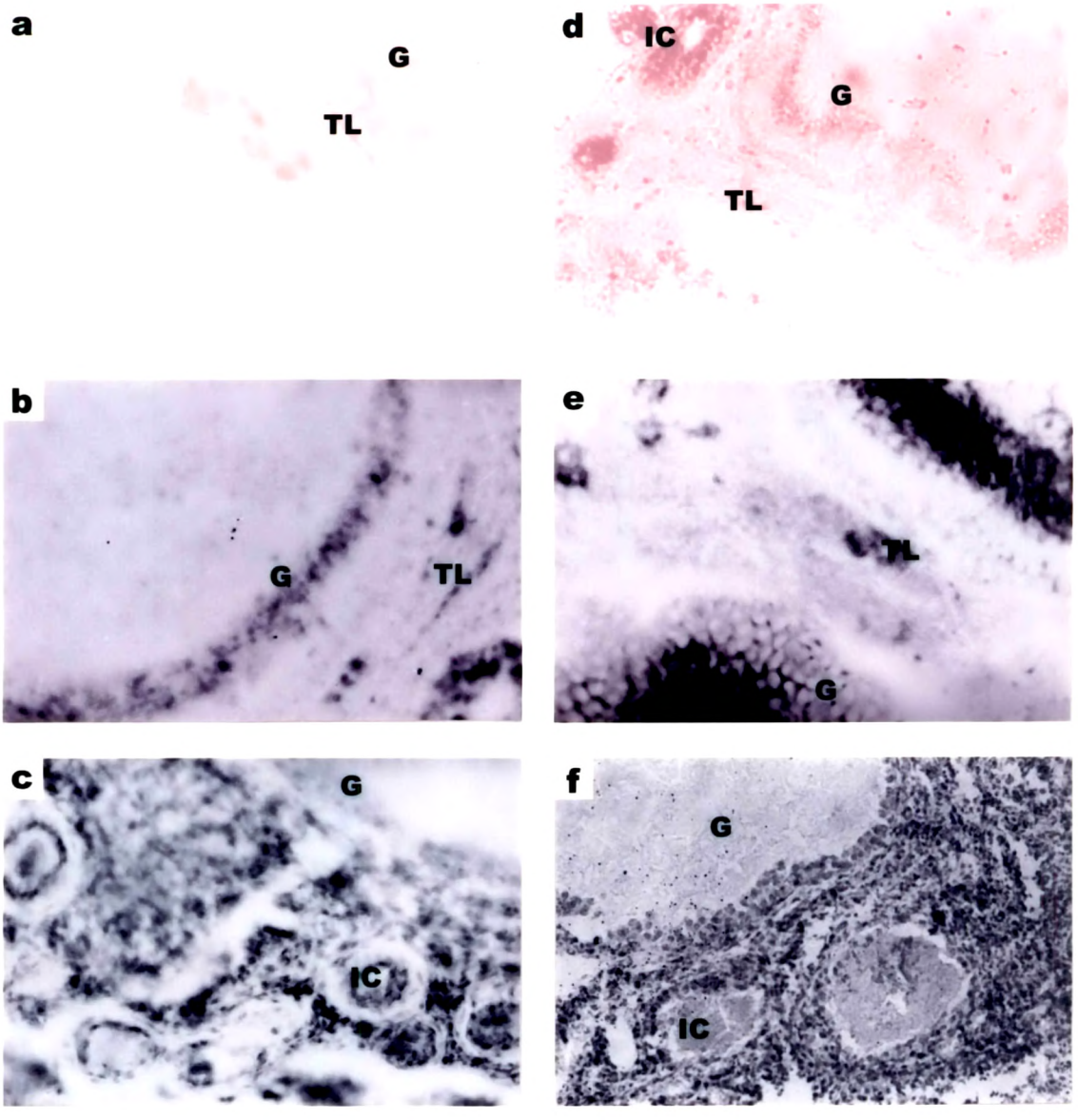


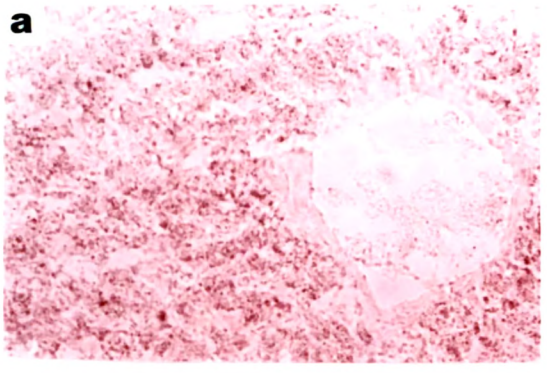
Plate XXVI

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

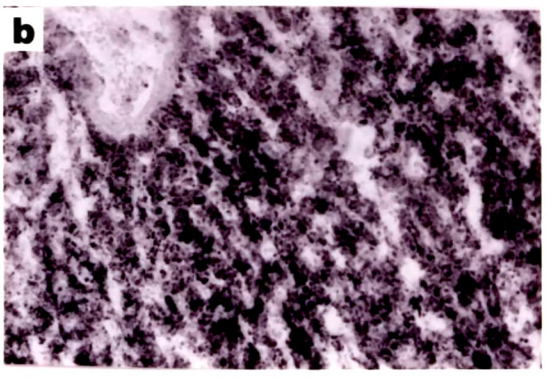
**- Pre-Breeding phase –**

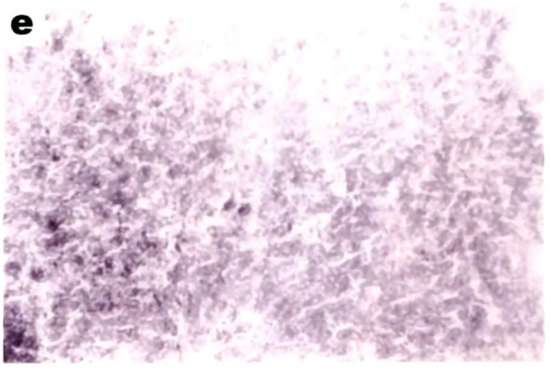
| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

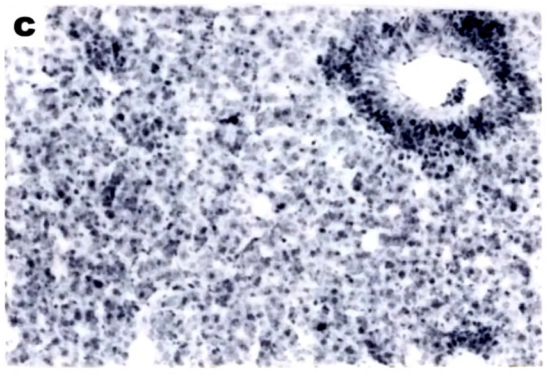
# PLATE XXVI







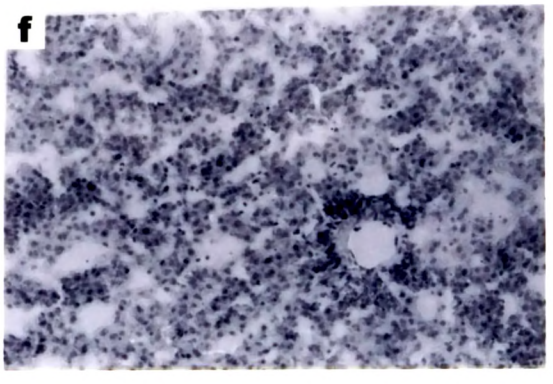



Plate XXVII

Histochemical localization of lipids in **intestine** of Bank Myna *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
EV : Epithelium of villi ; IG : Intestinal Glands

# PLATE **XXVII**

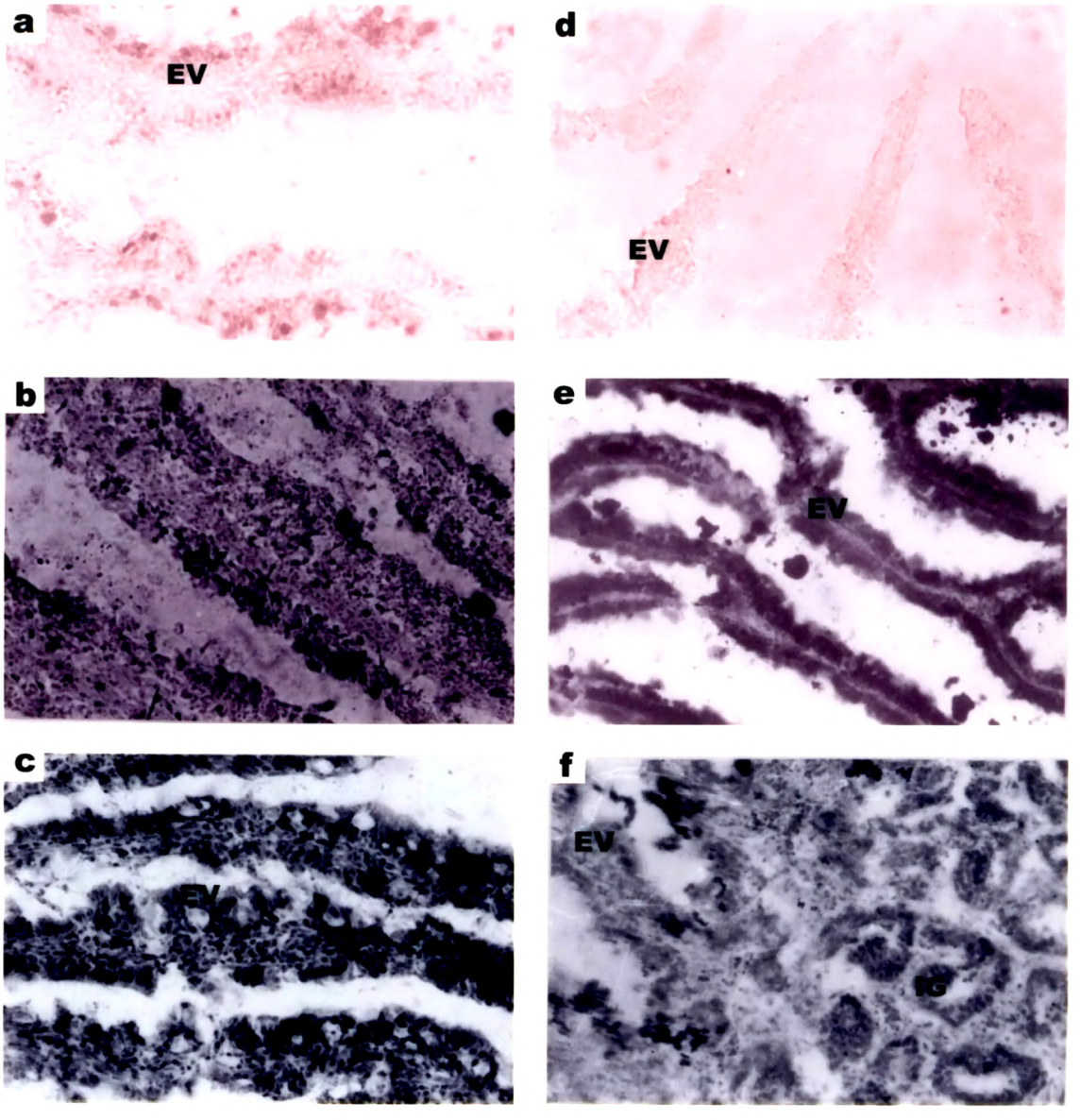


Plate XXVIII

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
NT : Nephric Tissue

# PLATE **XXVIII**

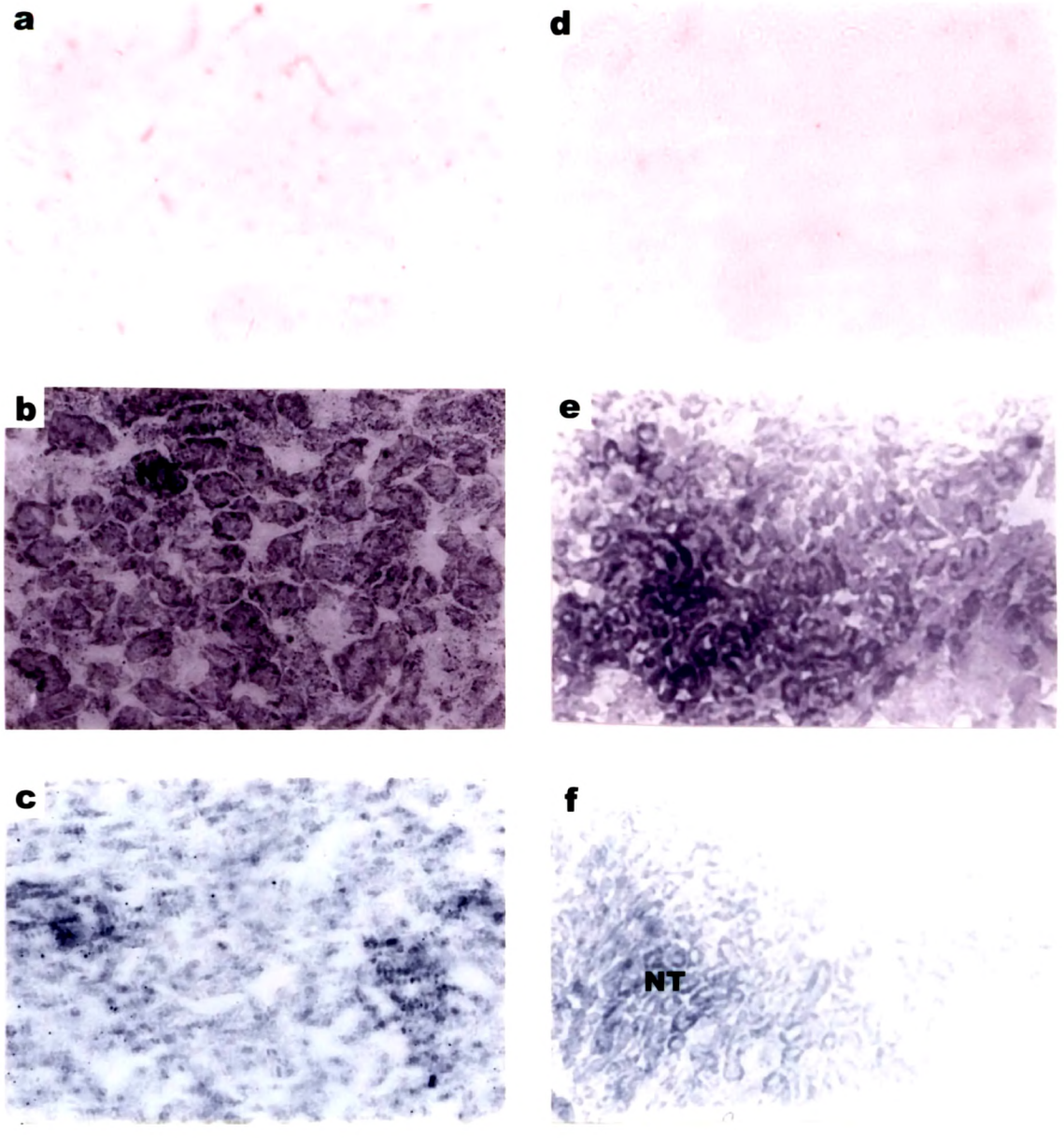


Plate XXIX

Histochemical localization of lipids in **testes** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
ST : Seminiferous Tubule ; LC : Leydig Cells

# PLATE XXIX

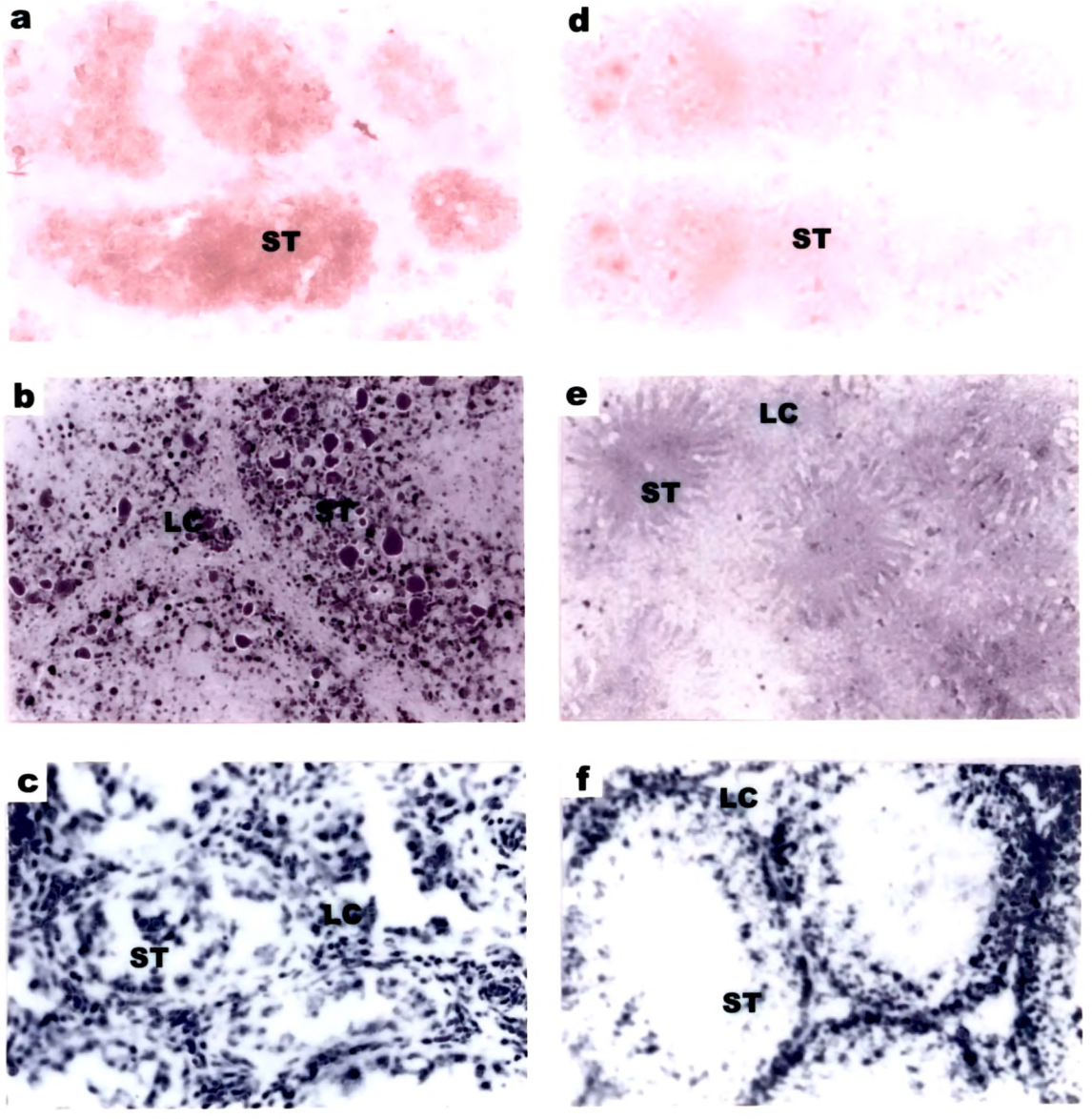


Plate XXX

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

# PLATE XXX

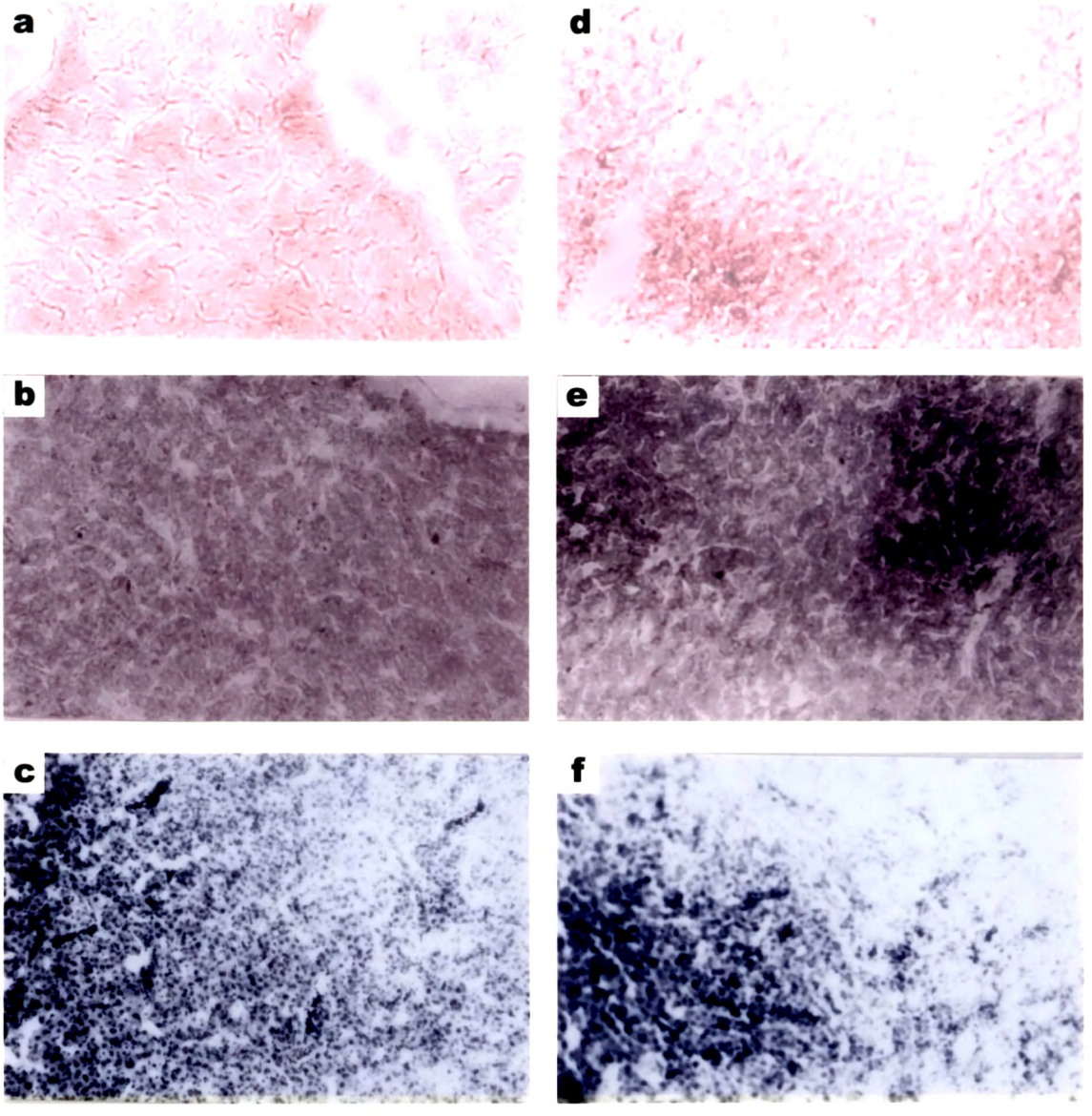


Plate XXXI

Histochemical localization of lipids in **intestine** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
EV : Epithelium of villi ; IG : Intestinal Glands

# PLATE XXXI

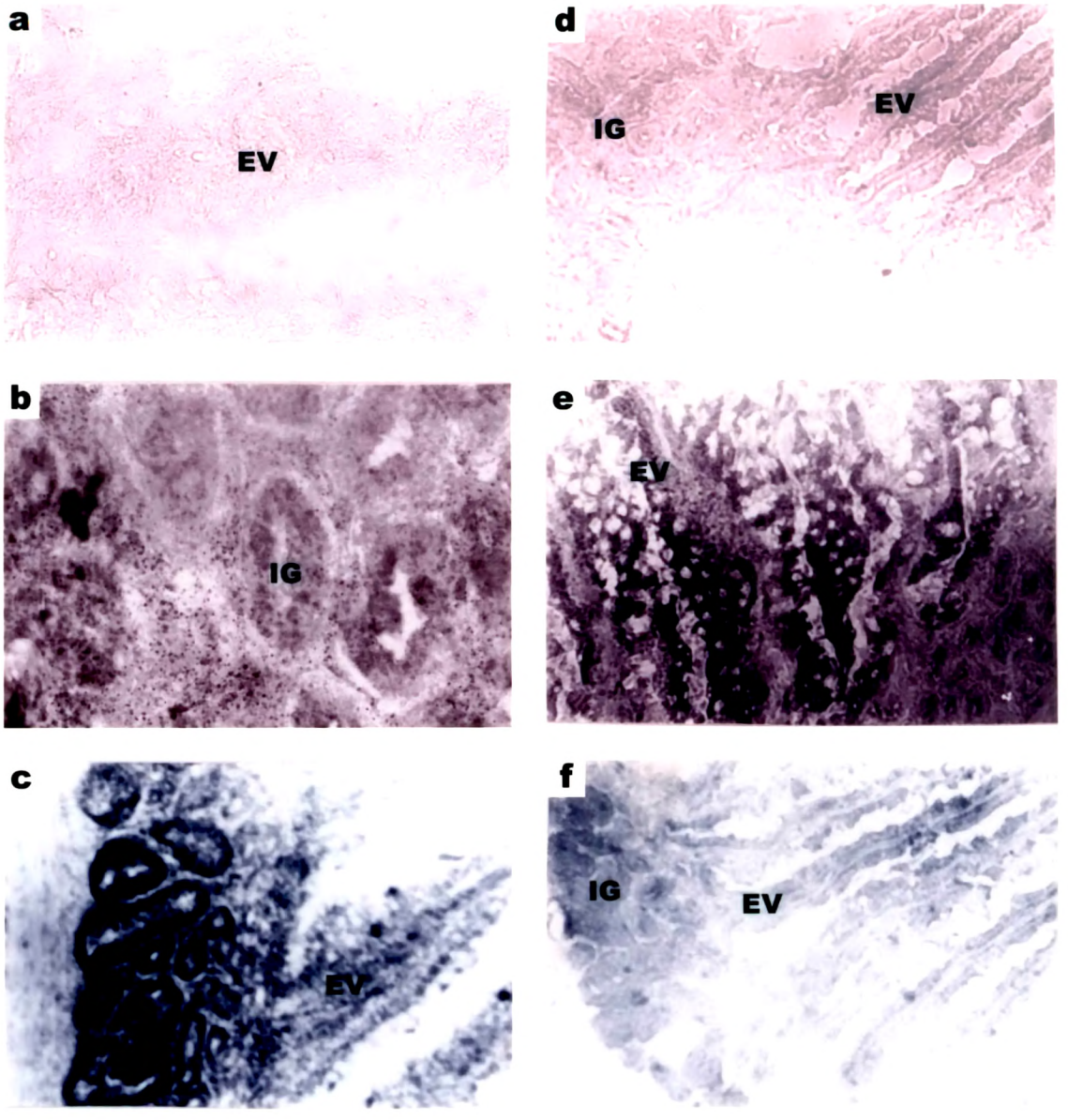


Plate XXXII

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
NT : Nephric Tissue

# PLATE XXXII

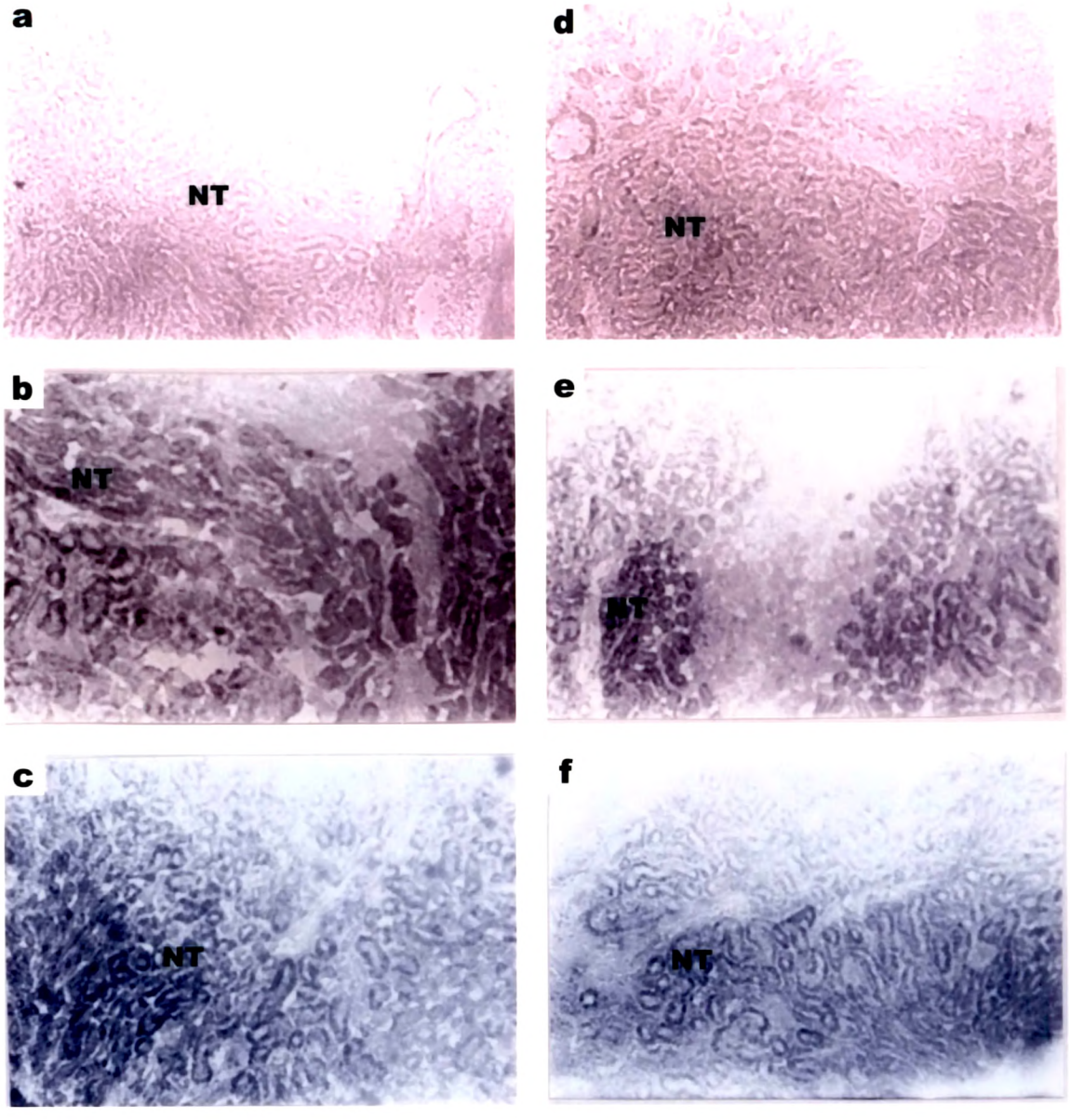


Plate XXXIII

Histochemical localization of lipids in **ovaries** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Breeding phase –**

| **Bank Myna** ♀ | | **Brahminy Myna** ♀ | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
Tl : Theca Layer ; G : Granulosa

# PLATE XXXIII

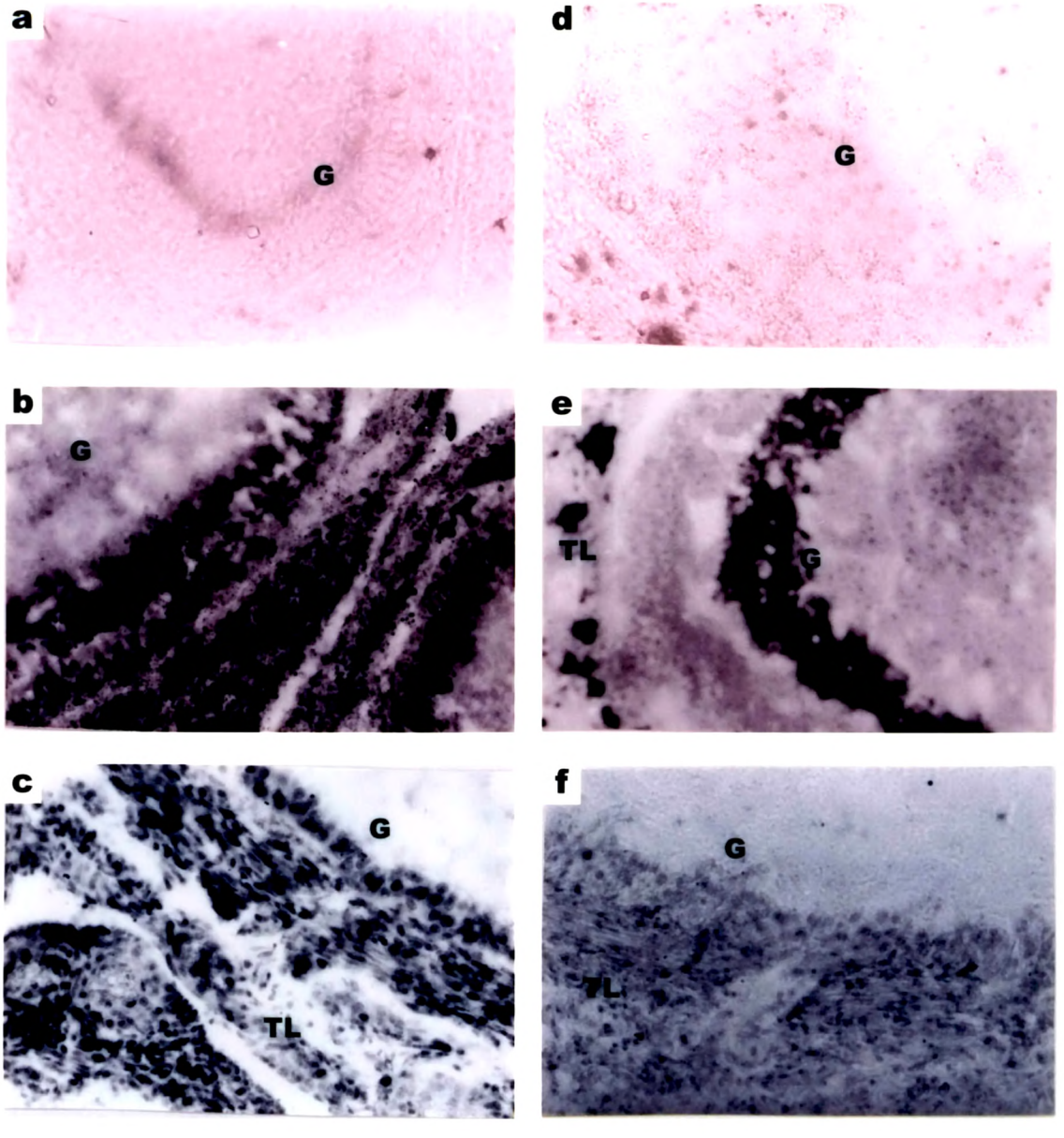


Plate XXXIV

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Breeding phase –**

**Bank Myna** ♀

a. Neutral lipids (500X)

b. Total lipids (800X)

c. Phospholipids (800X)

**Brahminy Myna** ♀

d. Neutral lipids (500X)

e. Total lipids (800X)

f. Phospholipids (500X)

# PLATE XXXIV

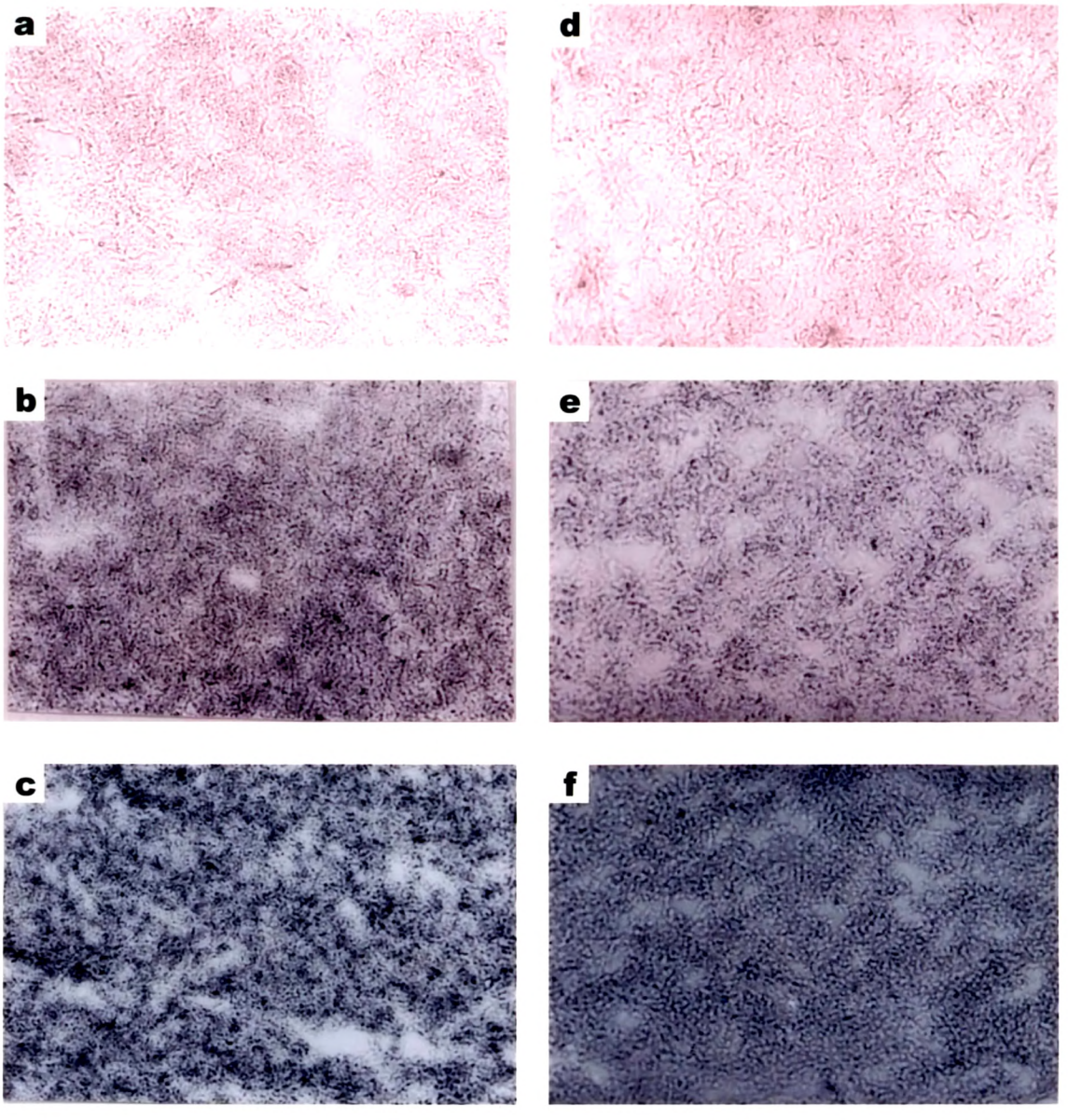


Plate XXXV

Histochemical localization of lipids in **intestine** of Bank Myna *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Breeding phase –**

| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
EV : Epithelium of villi ; IG : Intestinal Glands

# PLATE XXXV

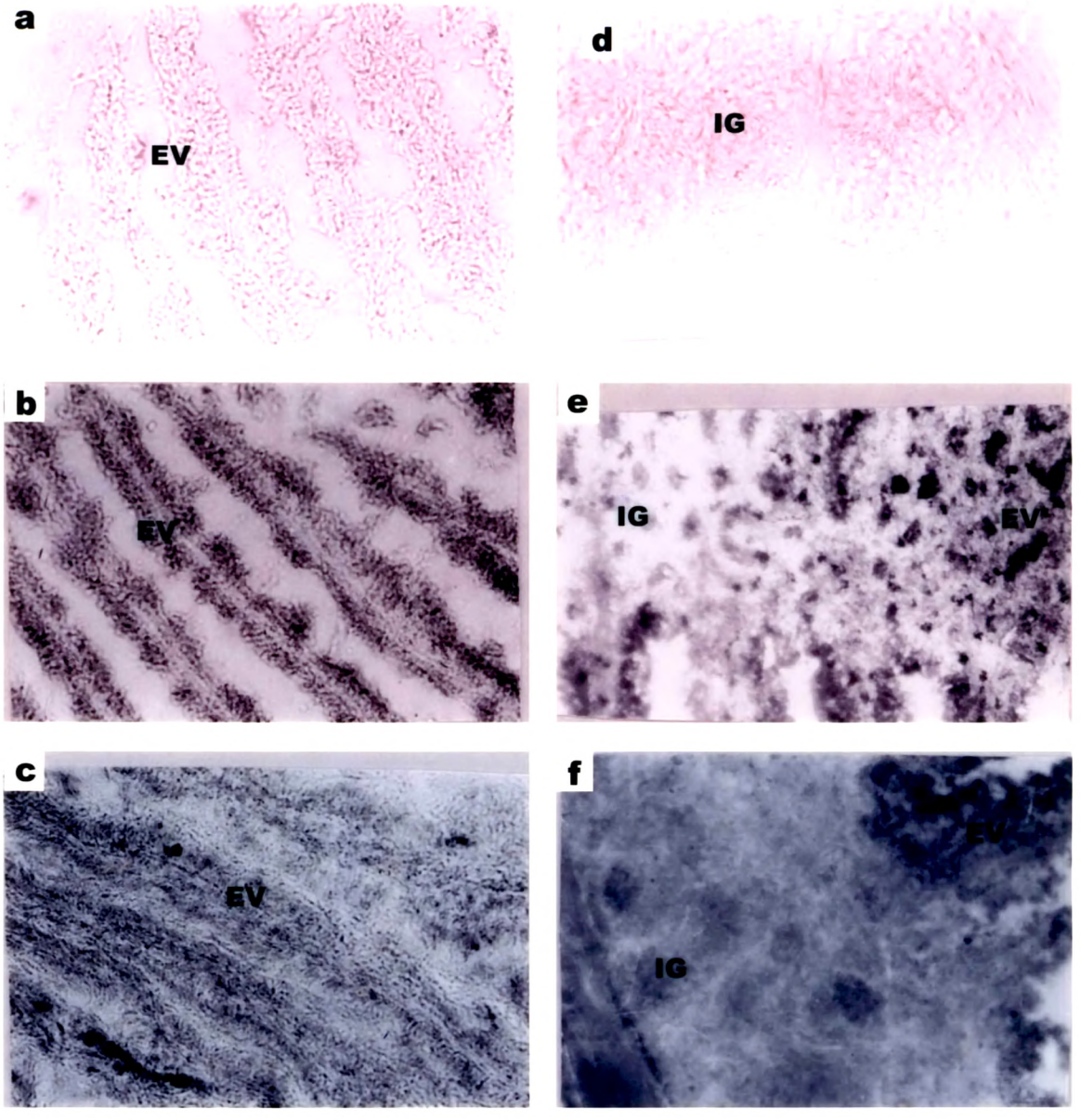


Plate XXXVI

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Breeding phase –**

**Bank Myna** ♀

a. Neutral lipids (500X)

b. Total lipids (800X)

c. Phospholipids (800X)

**Brahminy Myna** ♀

d. Neutral lipids (500X)

e. Total lipids (800X)

f. Phospholipids (500X)

# PLATE XXXVI

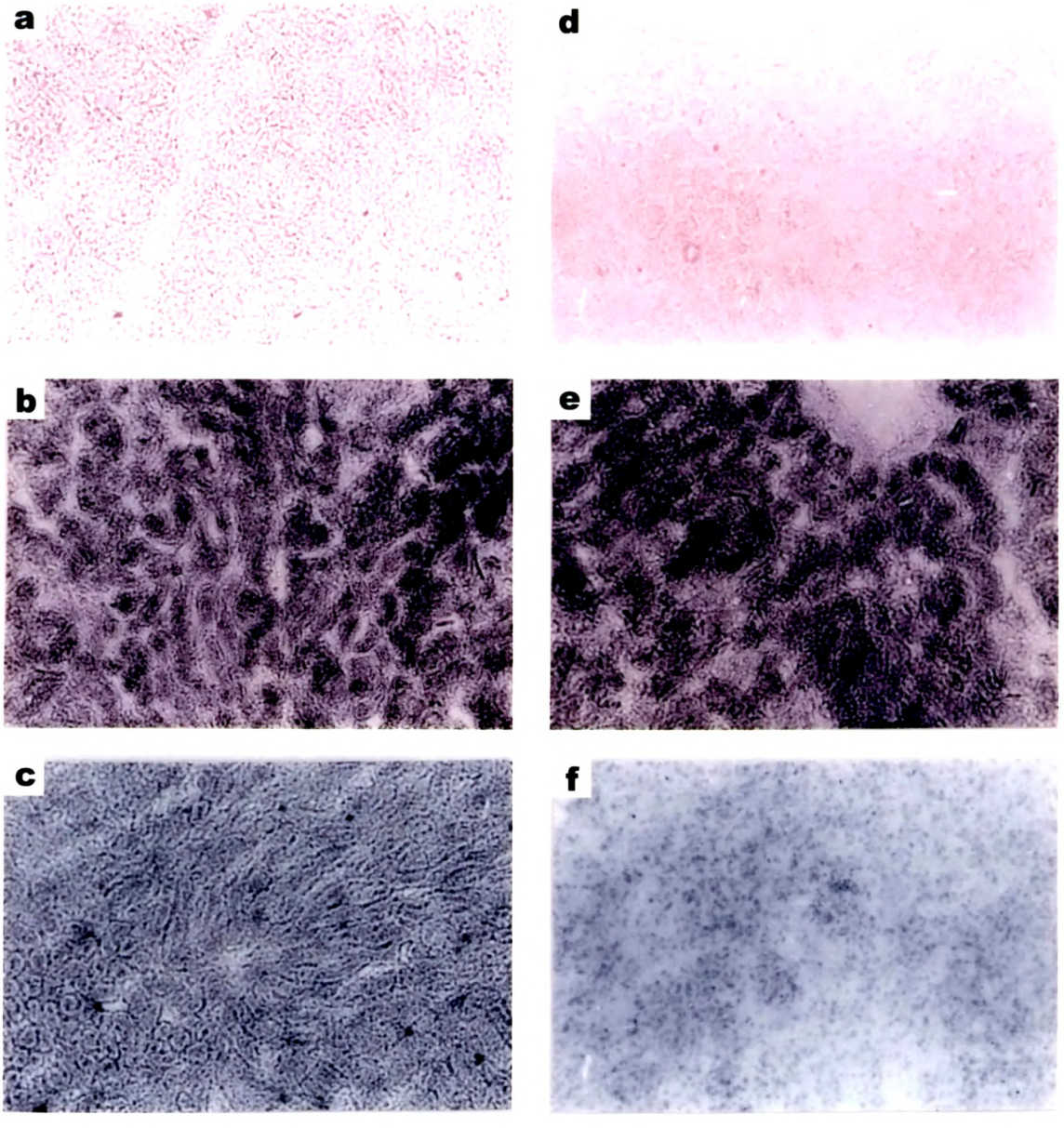


Plate XXXVII

Histochemical localization of lipids in **testes** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
ST : Seminiferous Tubule ; LC : Leydig Cells

# PLATE XXXVII

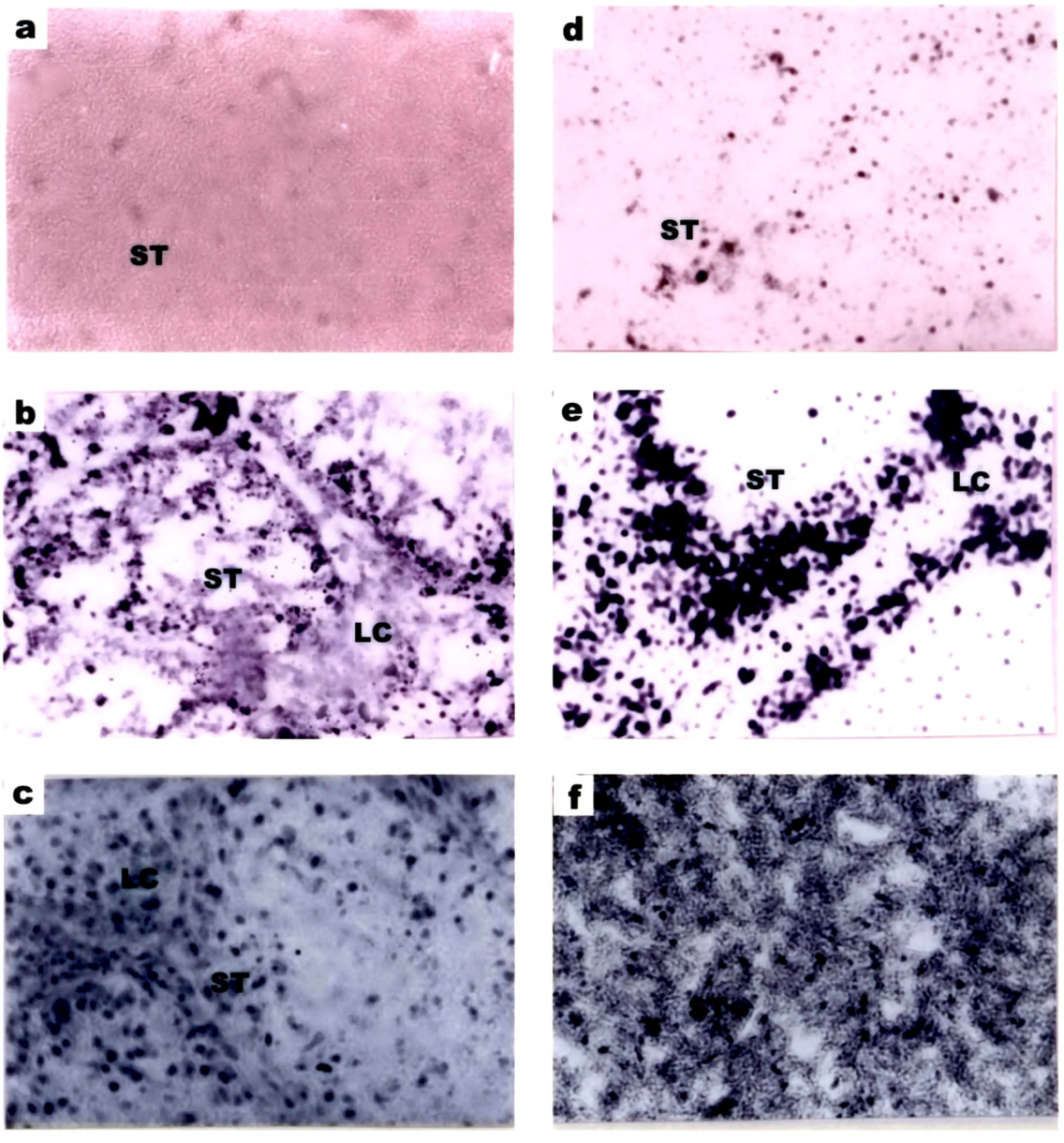


Plate XXXVIII

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

**Bank Myna ♂**

a. Neutral lipids (500X)

b. Total lipids (800X)

c. Phospholipids (800X)

**Brahminy Myna ♂**

d. Neutral lipids (500X)

e. Total lipids (800X)

f. Phospholipids (500X)

# PLATE **XXXVIII**

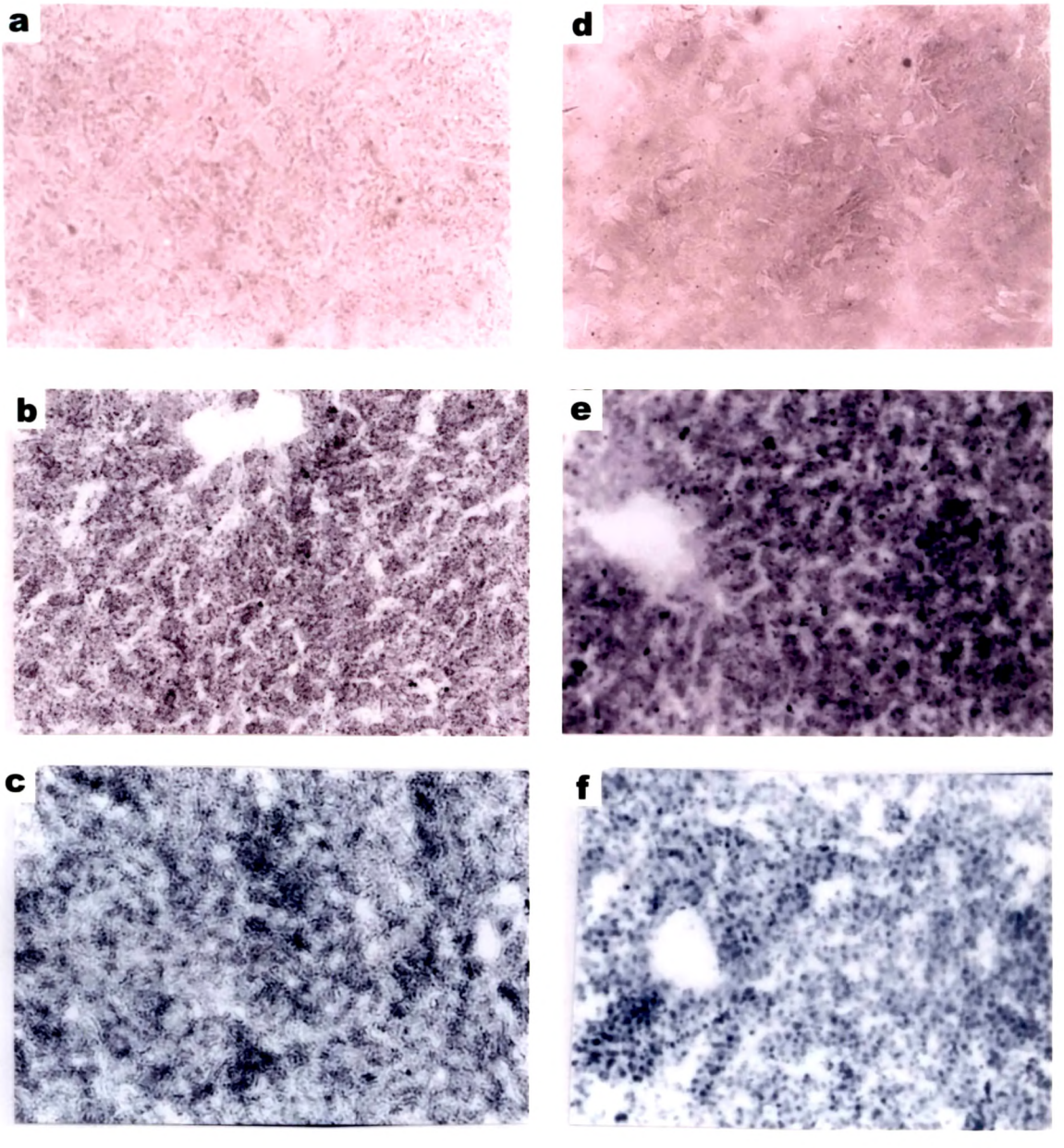


Plate XXXIX

Histochemical localization of lipids in **intestine** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
EV : Epithelium of villi

# PLATE XXXIX

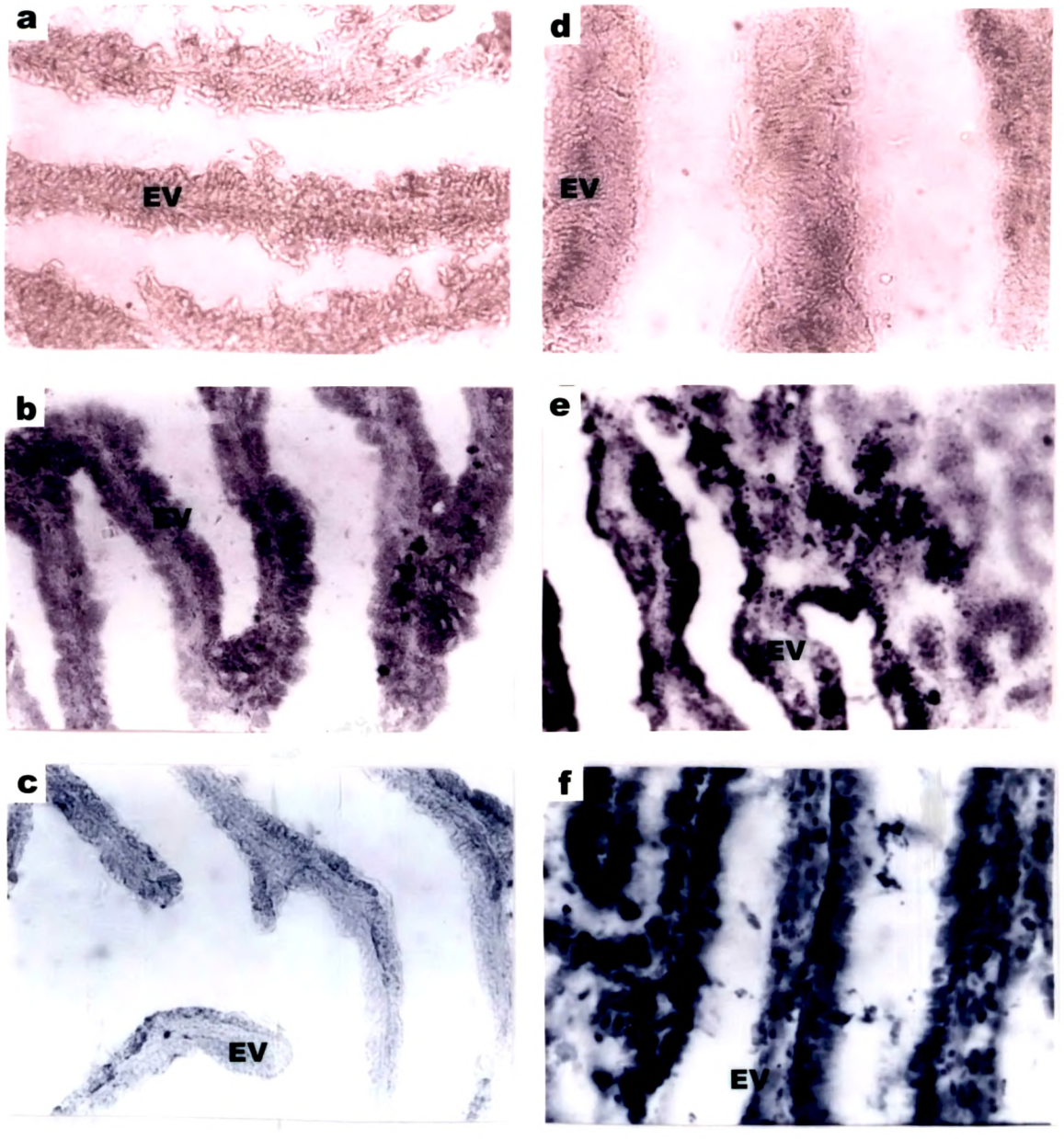


Plate XXXX

Histochemical localization of lipids in **kidney** of Bank Myna *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

# PLATE XXXX

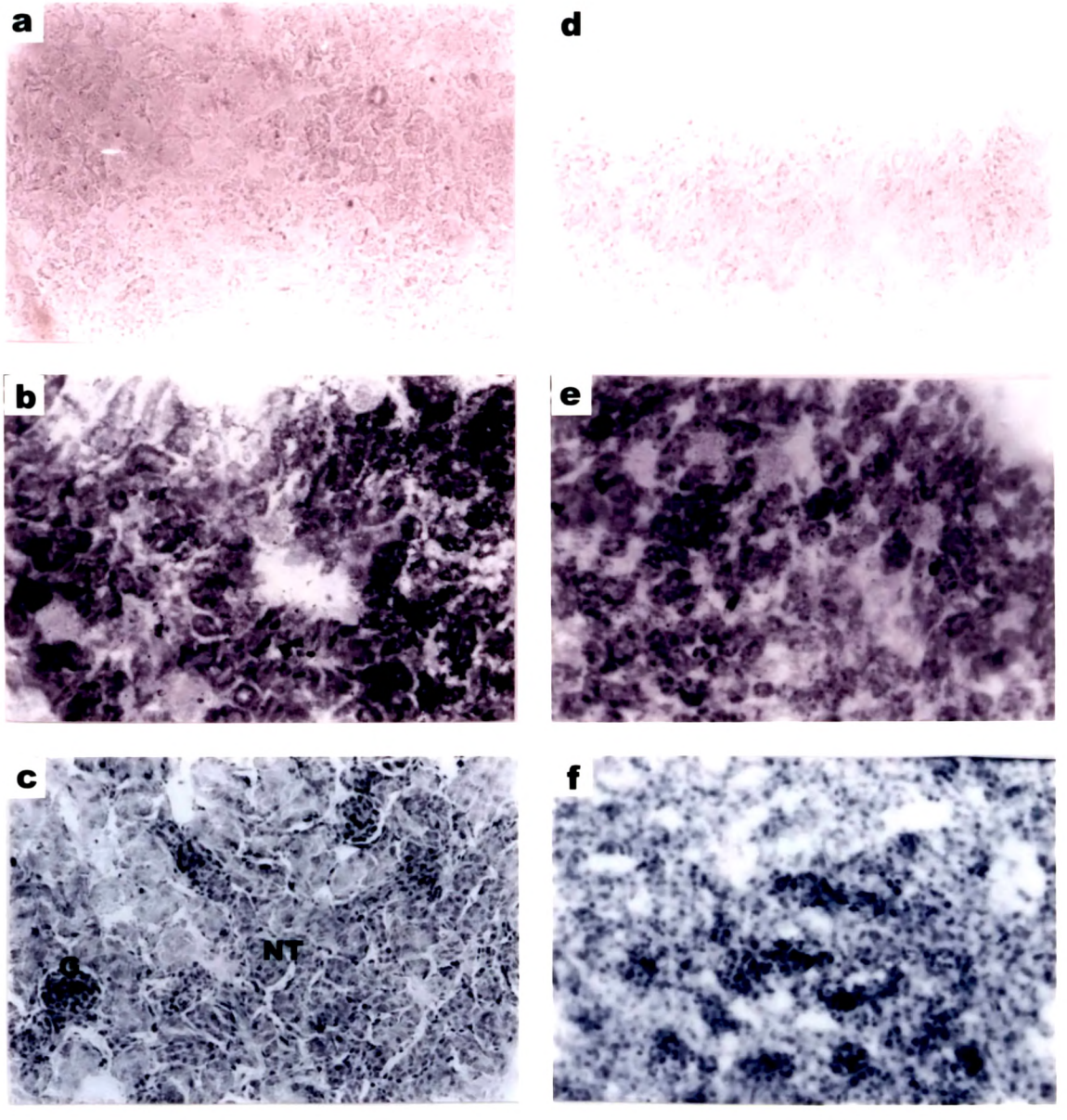


Plate XXXXI

Histochemical localization of lipids in **ovaries** of Bank Myna *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase –**

| **Bank Myna** ♀ | | **Brahminy Myna** ♀ | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
Tl : Theca Layer ; G : Granulosa ; IC ; Interstitial Cells

# PLATE XXXXI

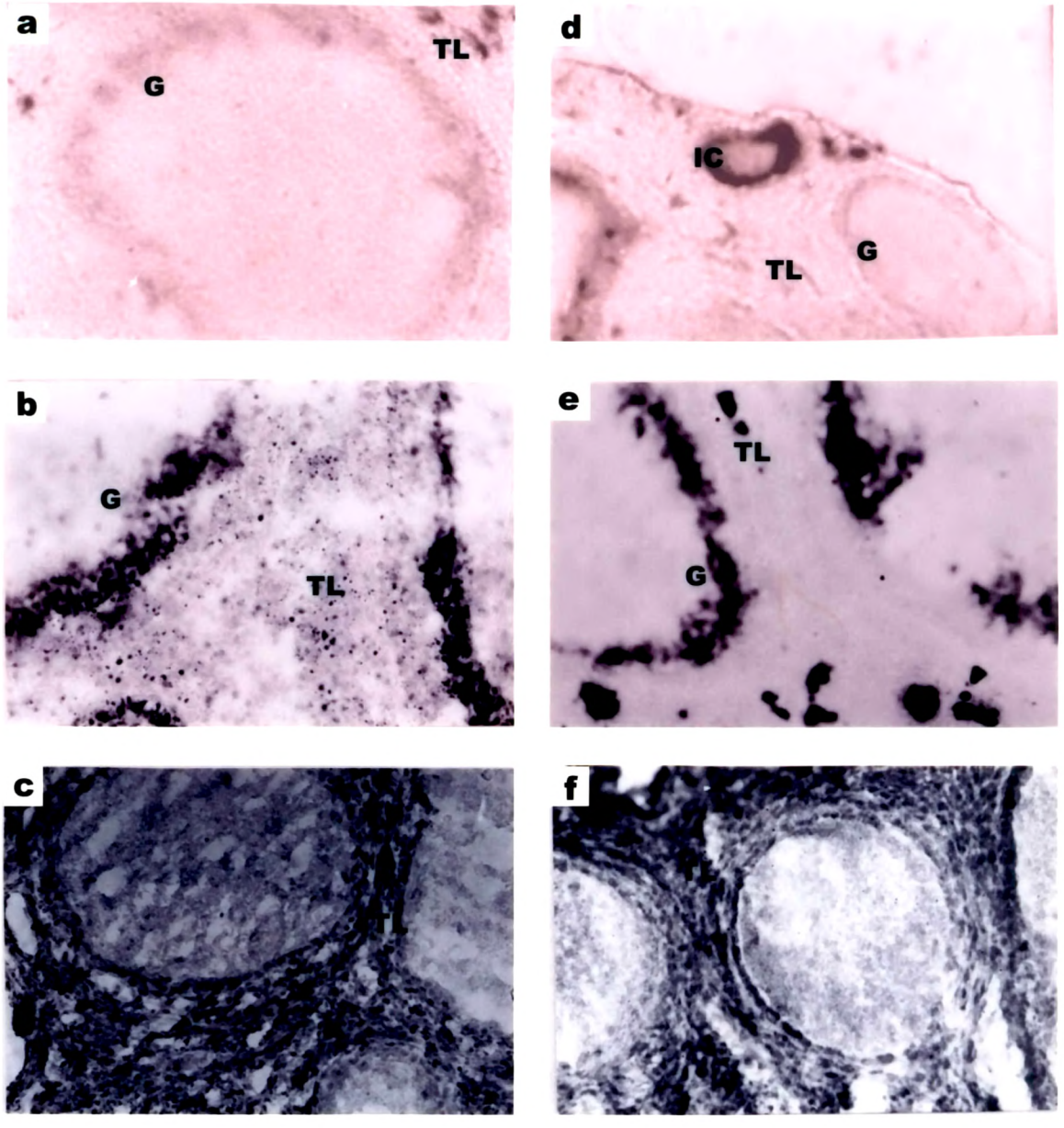


Plate XXXXII

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase –**

| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

# PLATE XXXXII

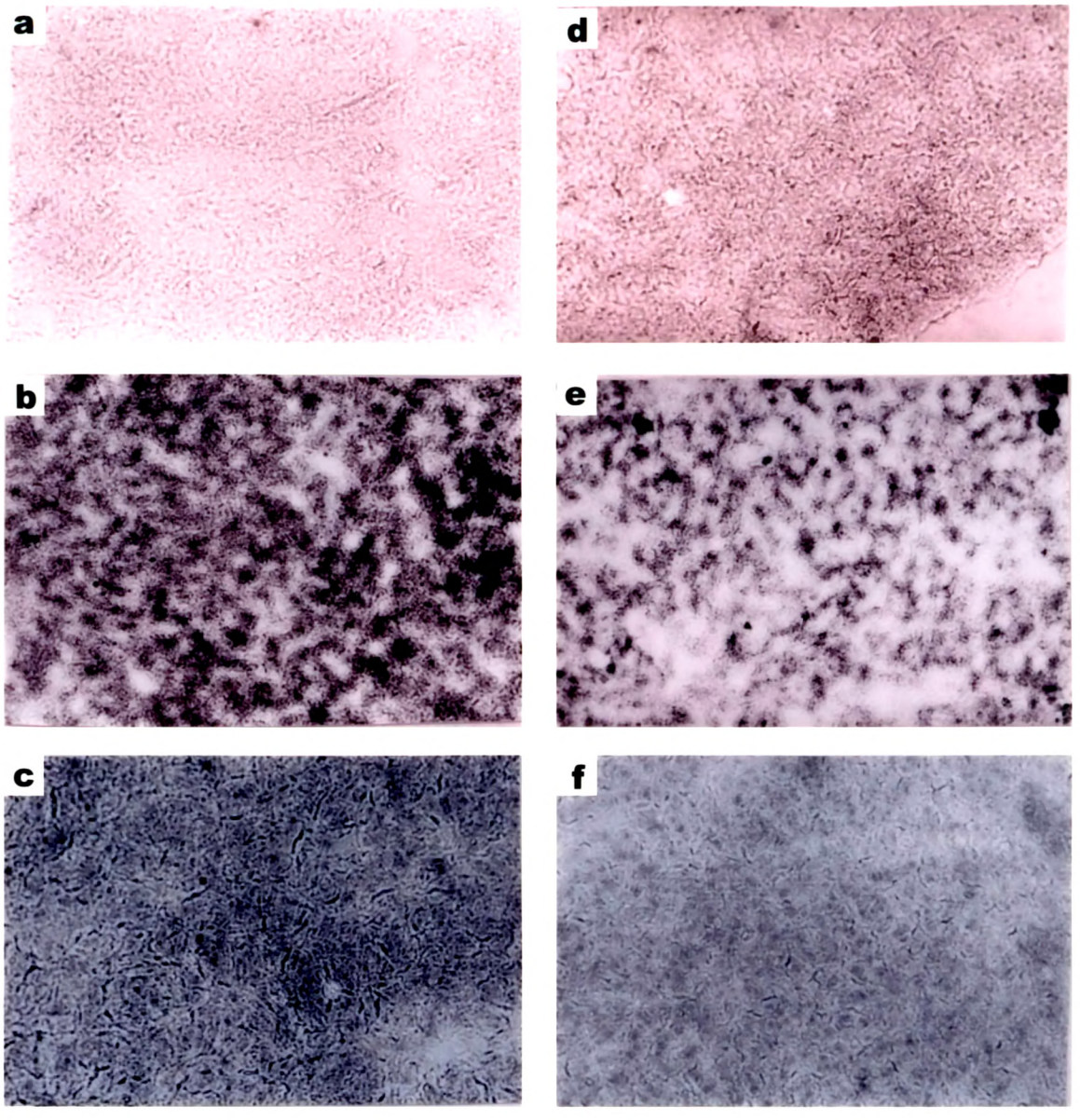


Plate XXXXIII

Histochemical localization of lipids in **intestine** of Bank Myna *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase –**

| **Bank Myna** ♀ | | **Brahminy Myna** ♀ | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
EV : Epithelium of villi ; IG : Intestinal Glands

# PLATE XXXXIII

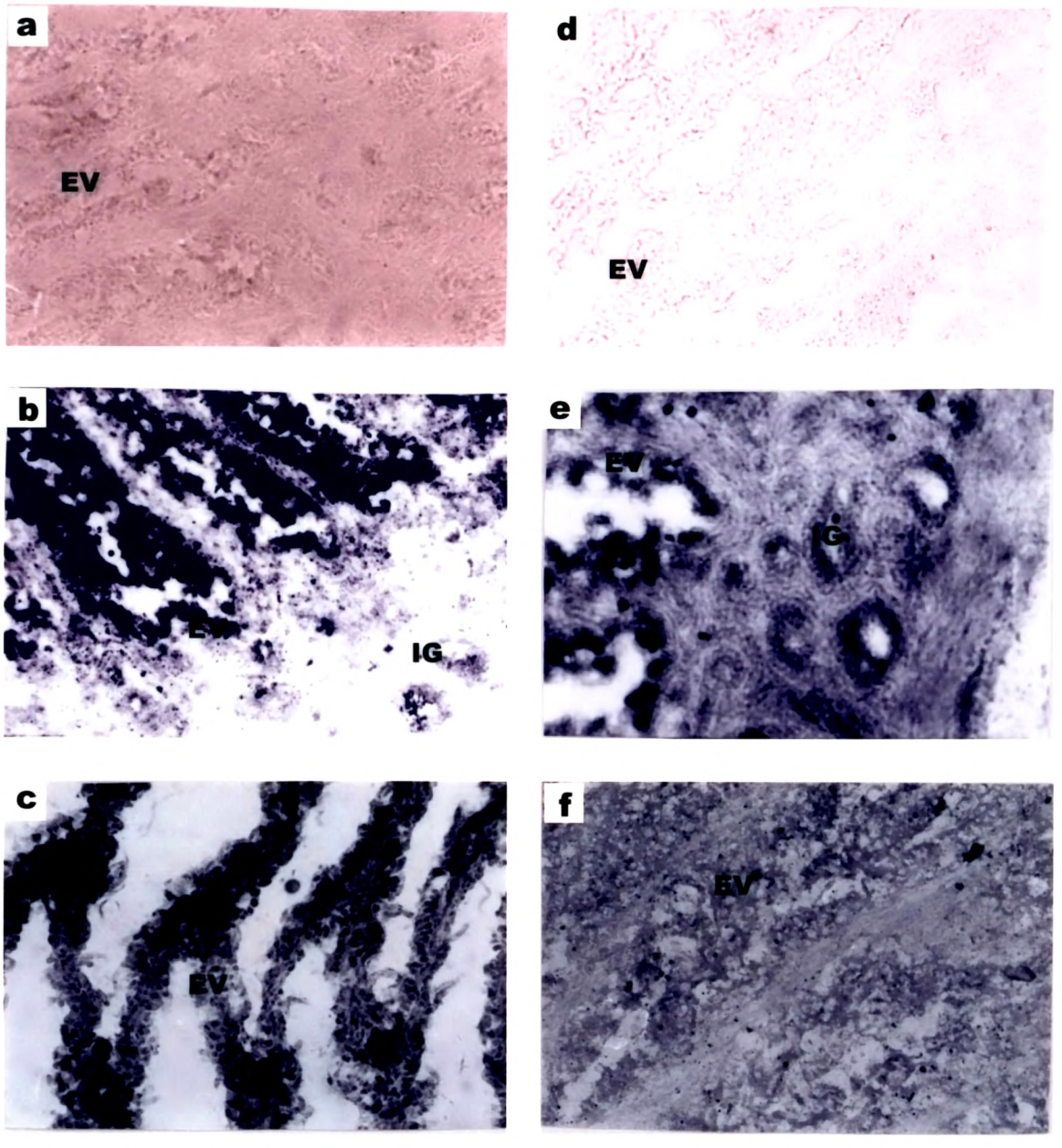


Plate XXXXIV

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase -**

| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

# PLATE **XXXXIV**

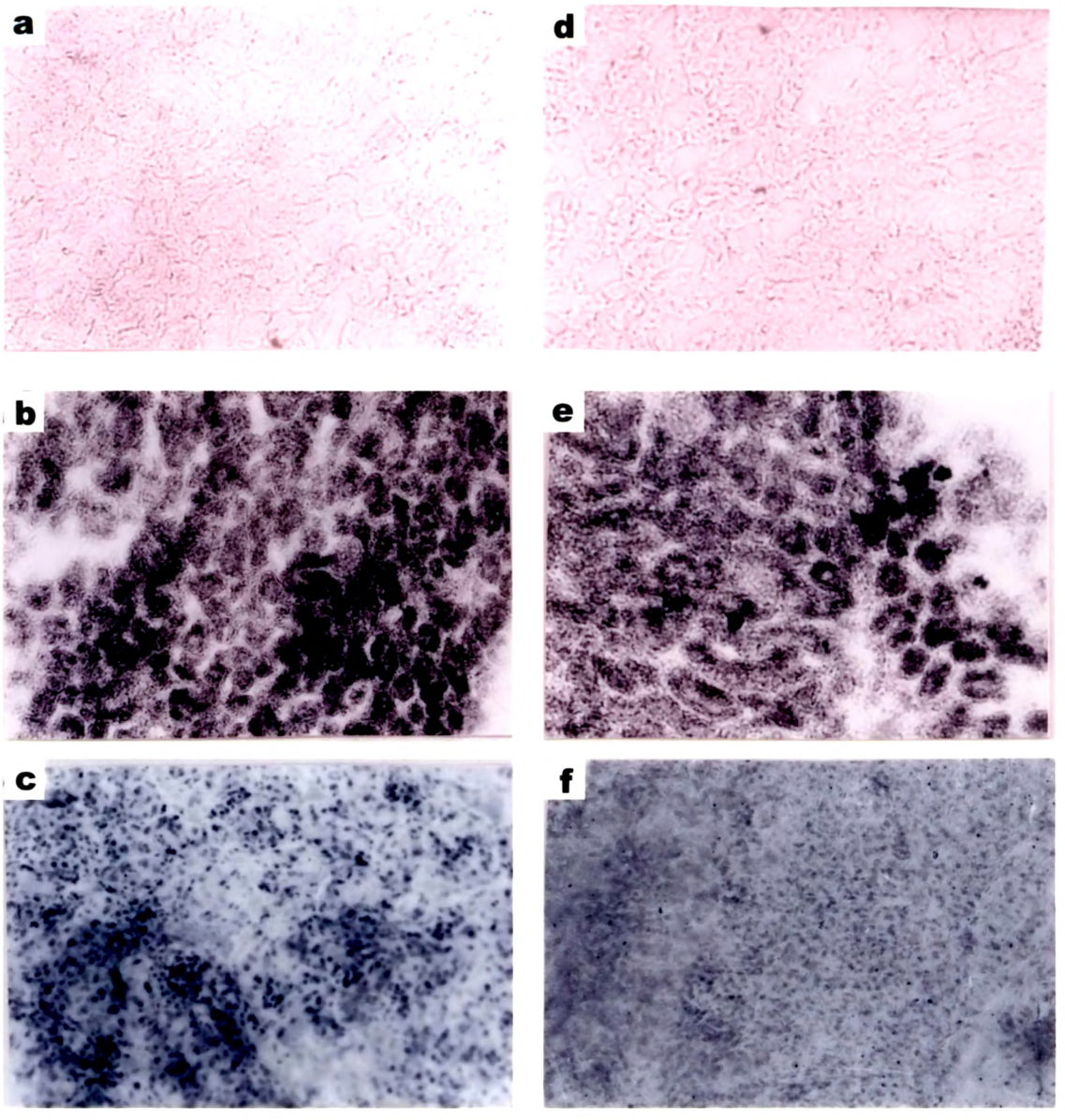


Plate XXXXV

Histochemical localization of lipids in **testes** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
ST : Seminiferous Tubule

# PLATE XXXXV

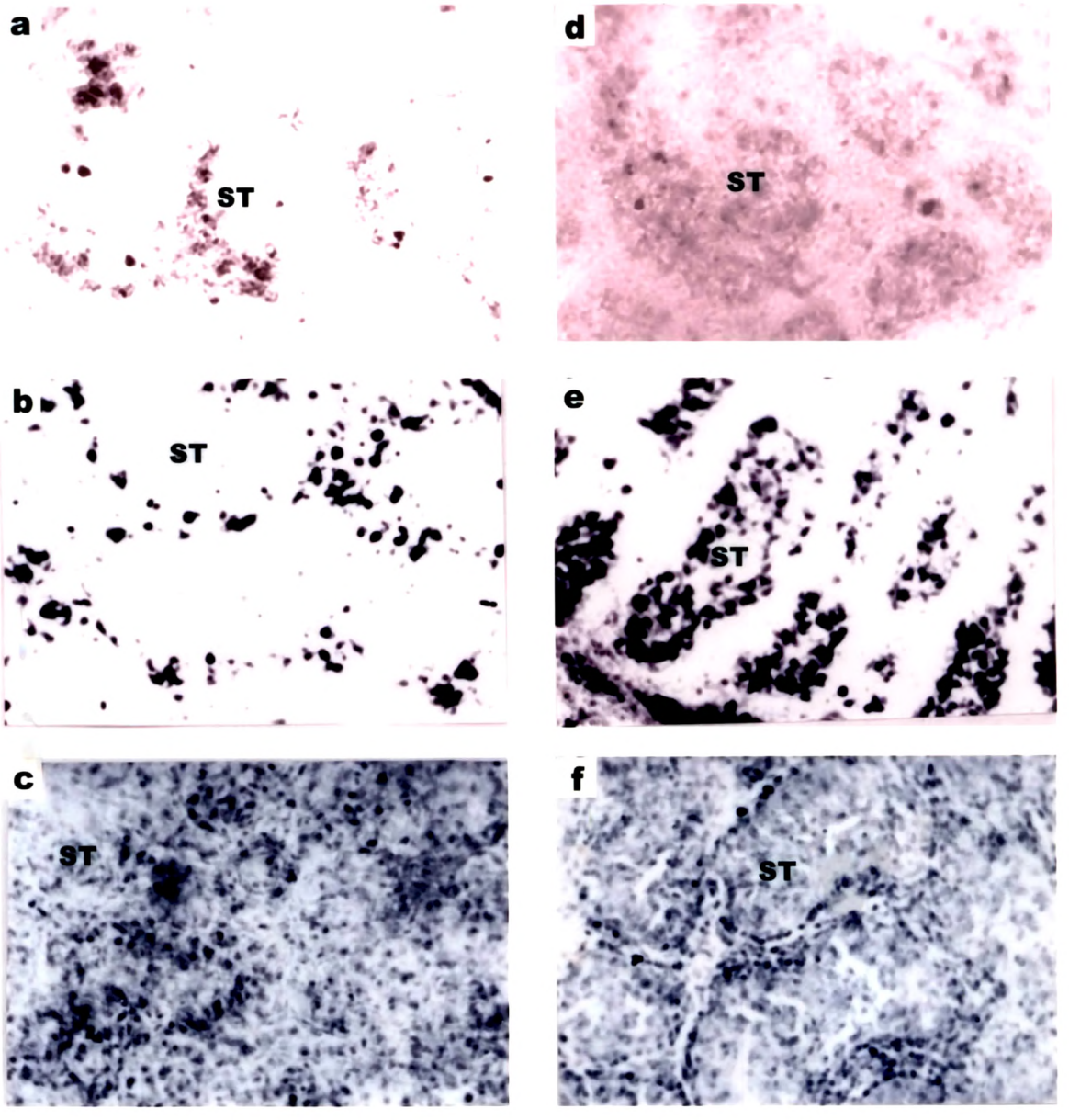


Plate XXXXVI

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase –**

**Bank Myna ♂**

a. Neutral lipids (500X)

b. Total lipids (800X)

c. Phospholipids (800X)

**Brahminy Myna ♂**

d. Neutral lipids (500X)

e. Total lipids (800X)

f. Phospholipids (500X)

# PLATE XXXXVI

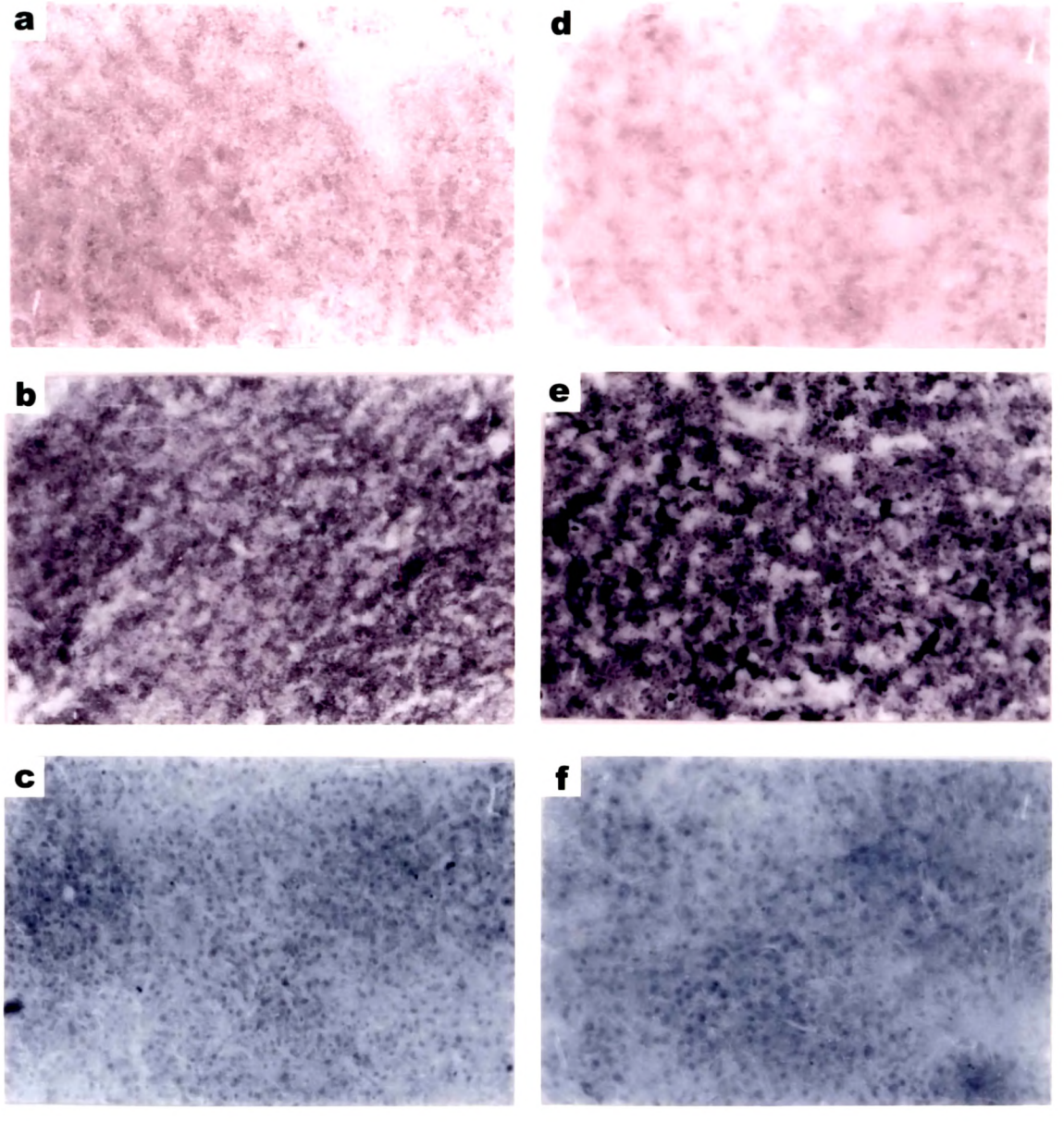


Plate XXXXVII

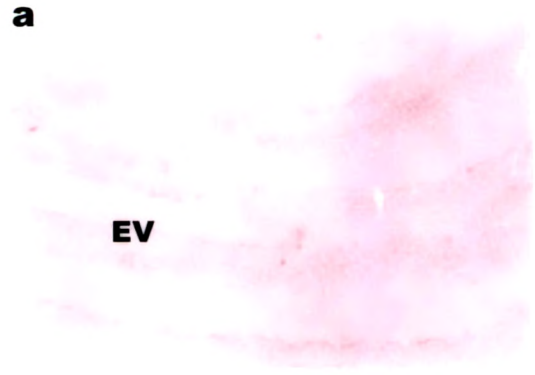
Histochemical localization of lipids in **intestine** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Post-Breeding phase –**

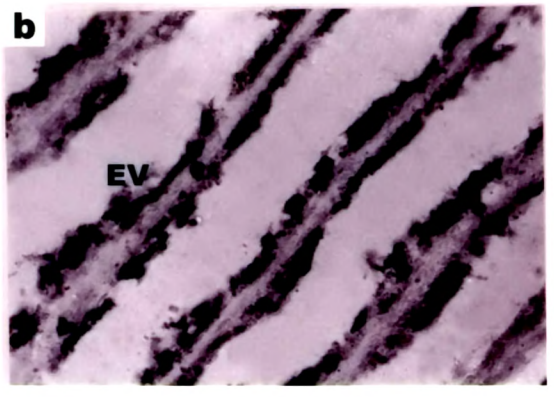
| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

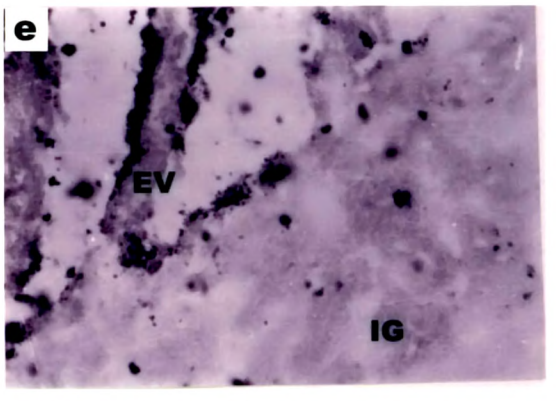
Abbreviation :
EV : Epithelium of villi ; IG : Intestinal Glands

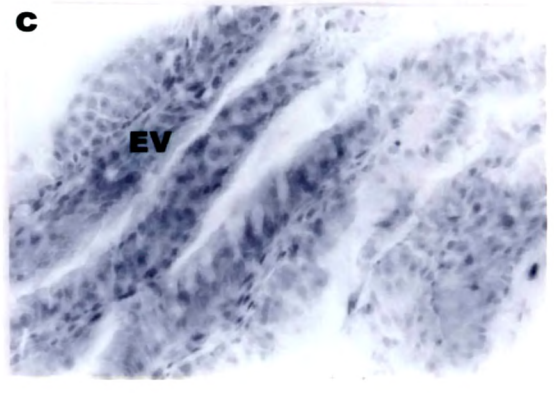
# PLATE XXXXVII







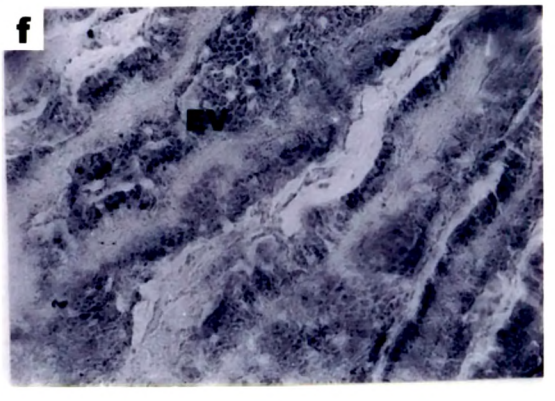



Plate XXXXVIII

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Pre-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

# PLATE XXXXVIII

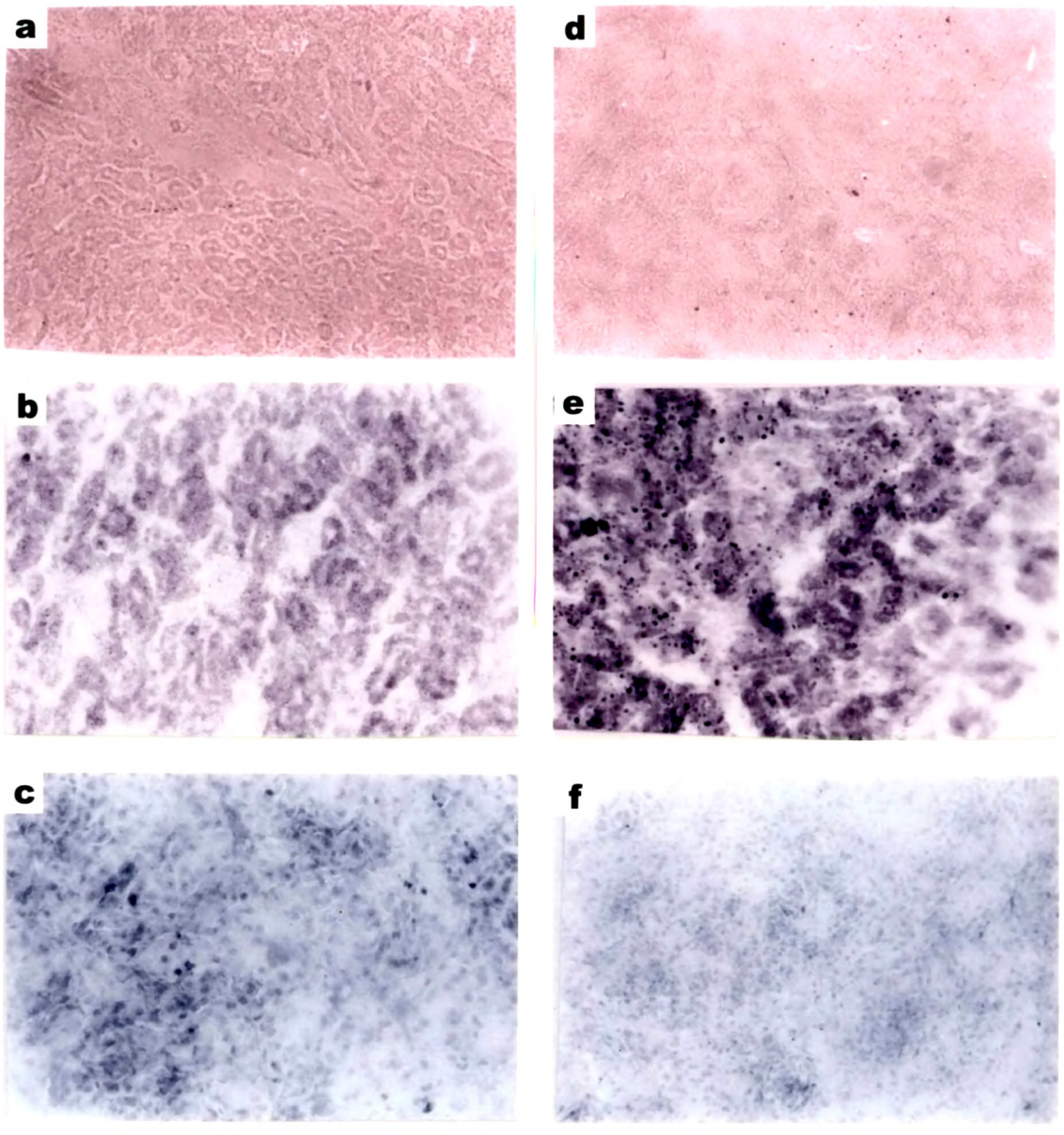


Plate XXXXIX

Histochemical localization of lipids in **ovaries** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Non-Breeding phase –**

| **Bank Myna** ♀ | | **Brahminy Myna** ♀ | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
G : Granulosa ; IG : Intestinal Glands

# PLATE XXXXIX

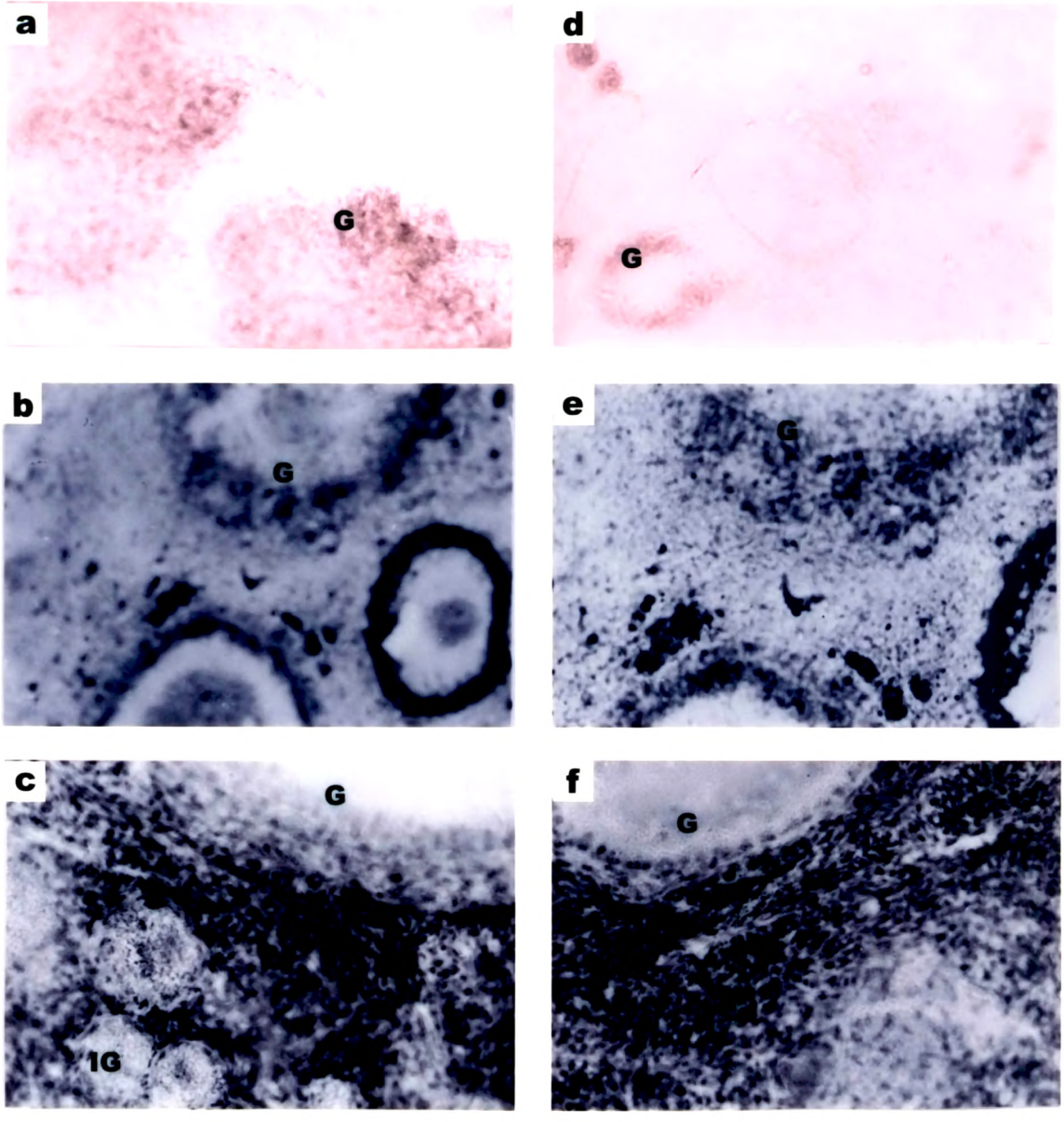


Plate L

Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Non-Breeding phase –**

**Bank Myna ♀**

a. Neutral lipids (500X)

b. Total lipids (800X)

c. Phospholipids (800X)

**Brahminy Myna ♀**

d. Neutral lipids (500X)

e. Total lipids (800X)

f. Phospholipids (500X)

# PLATE L

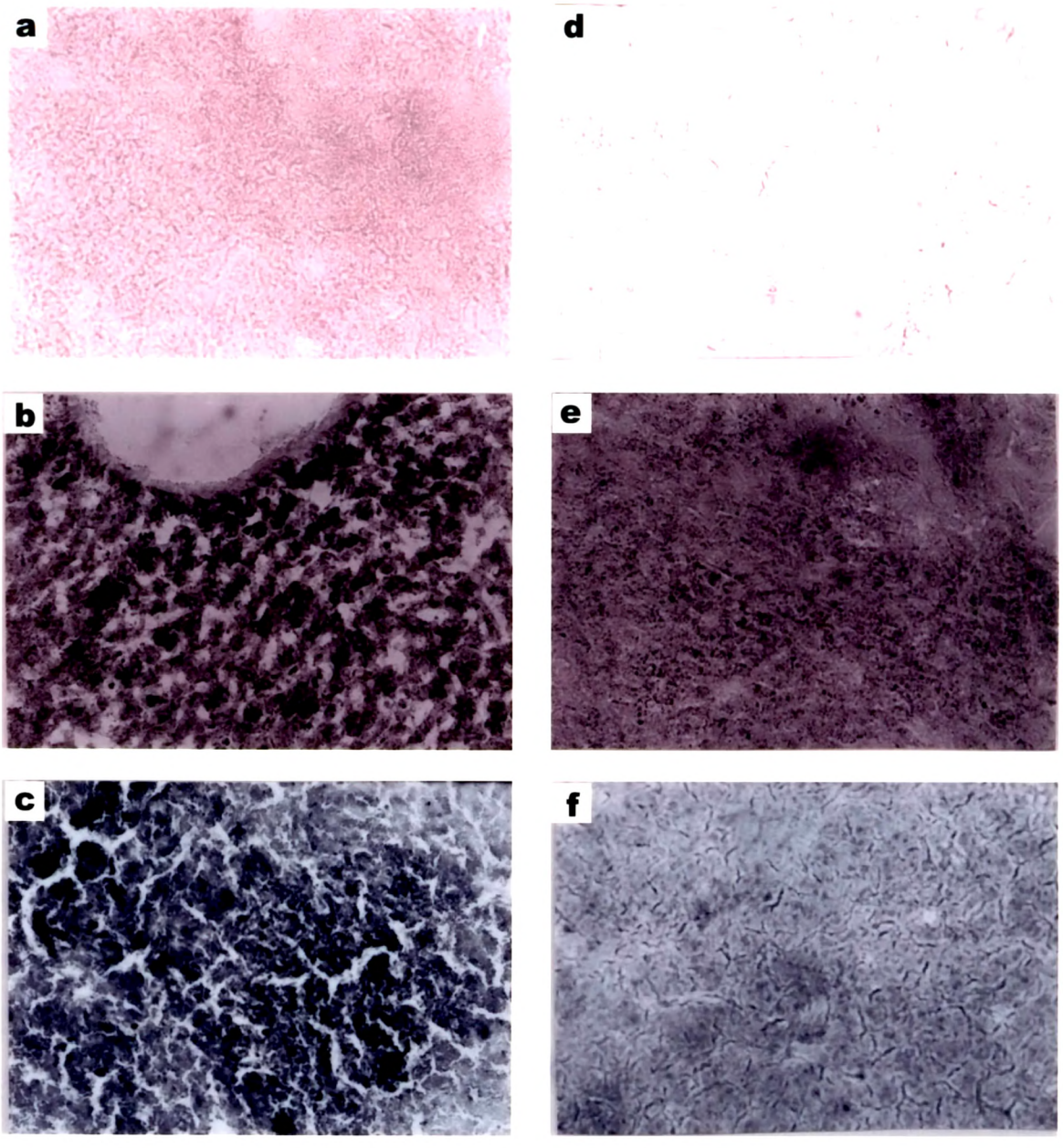


Plate LI

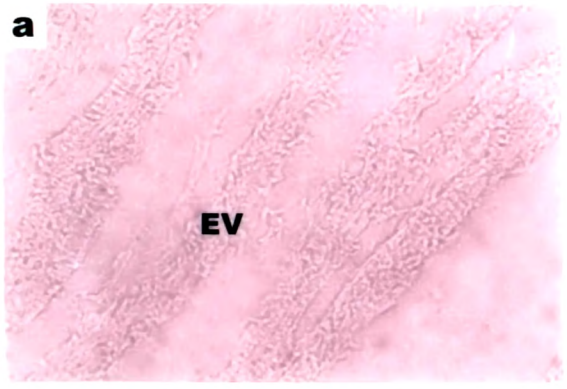
Histochemical localization of lipids in **intestine** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

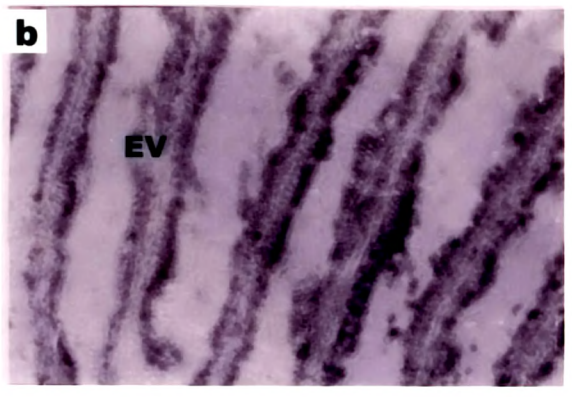
**- Non-Breeding phase –**

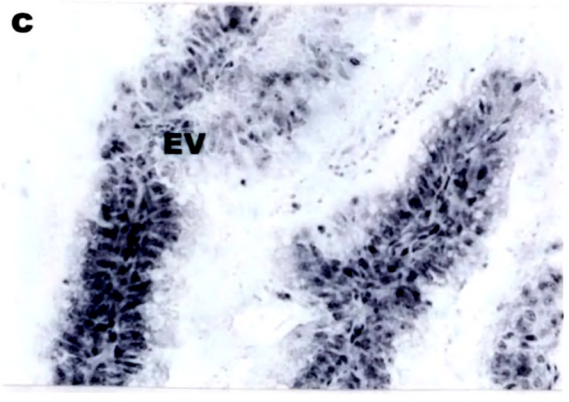
| **Bank Myna ♀** | | **Brahminy Myna ♀** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

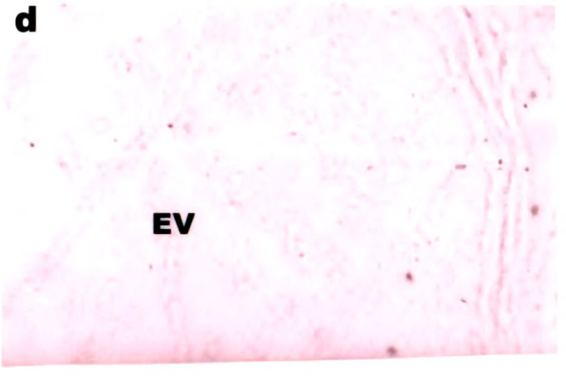
Abbreviation :
EV : Epithelium of villi

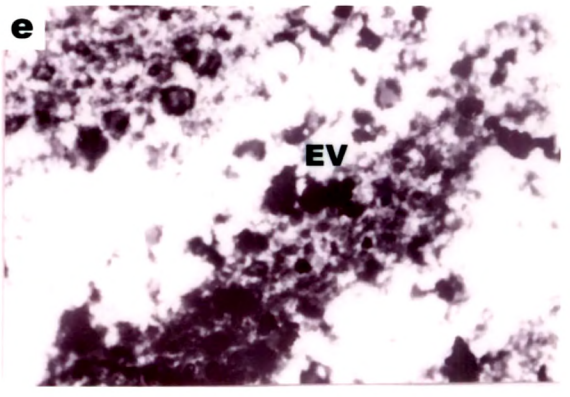
# PLATE **LI**



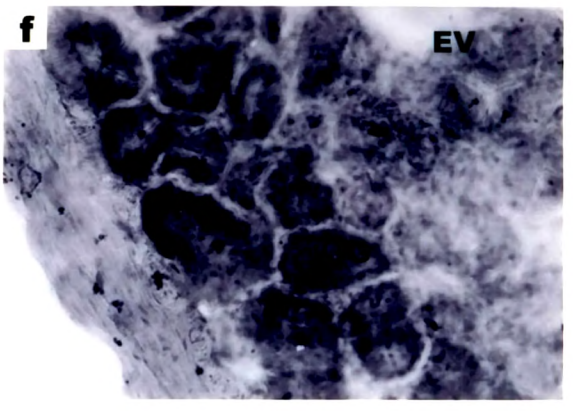



Plate LII

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Non-Breeding phase –**

| **Bank Myna** ♀ | | **Brahminy Myna** ♀ | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

# PLATE LII

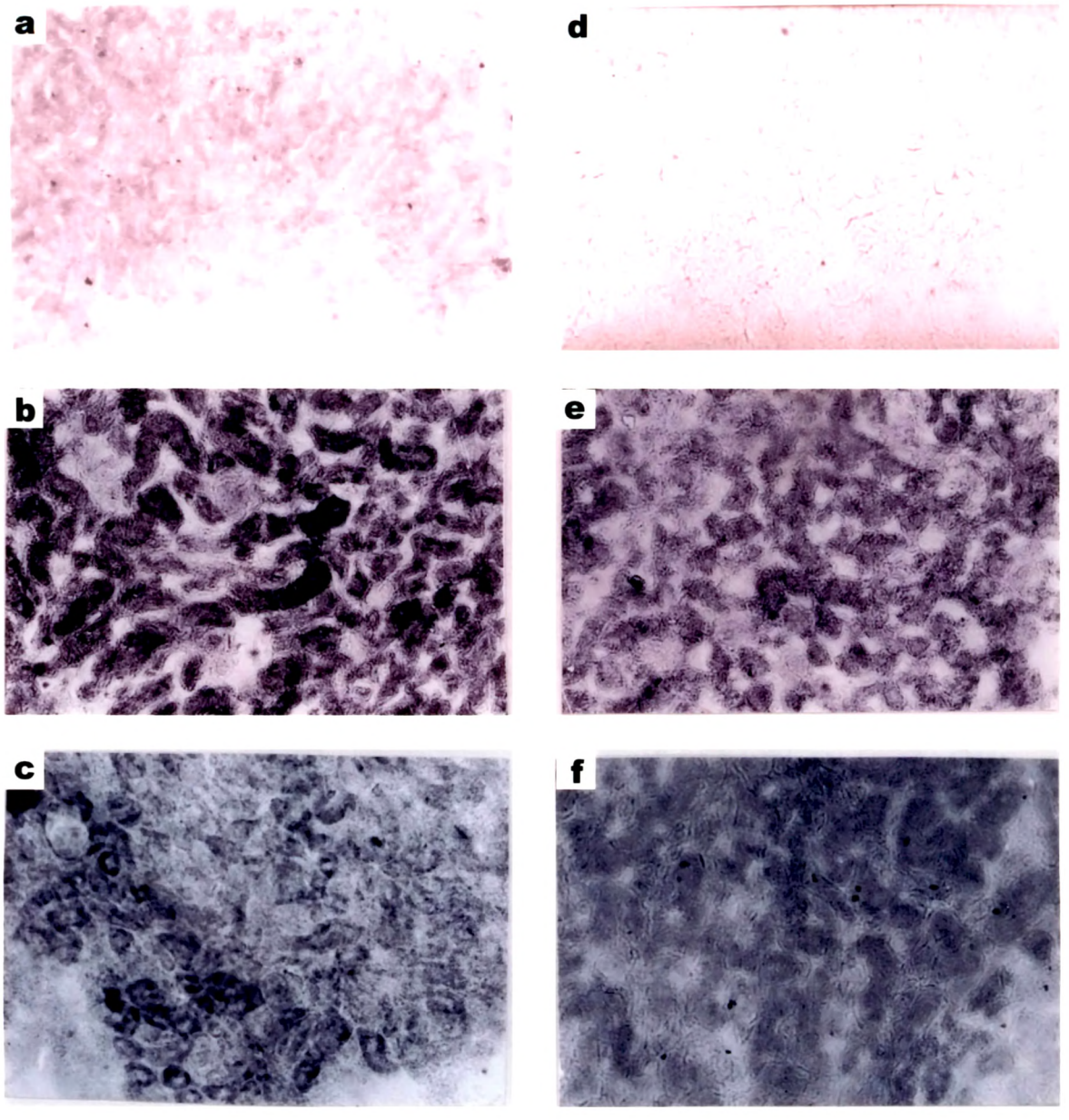


Plate LIII

Histochemical localization of lipids in **testes** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Non-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
ST : Seminiferous Tubule

# PLATE **LIII**

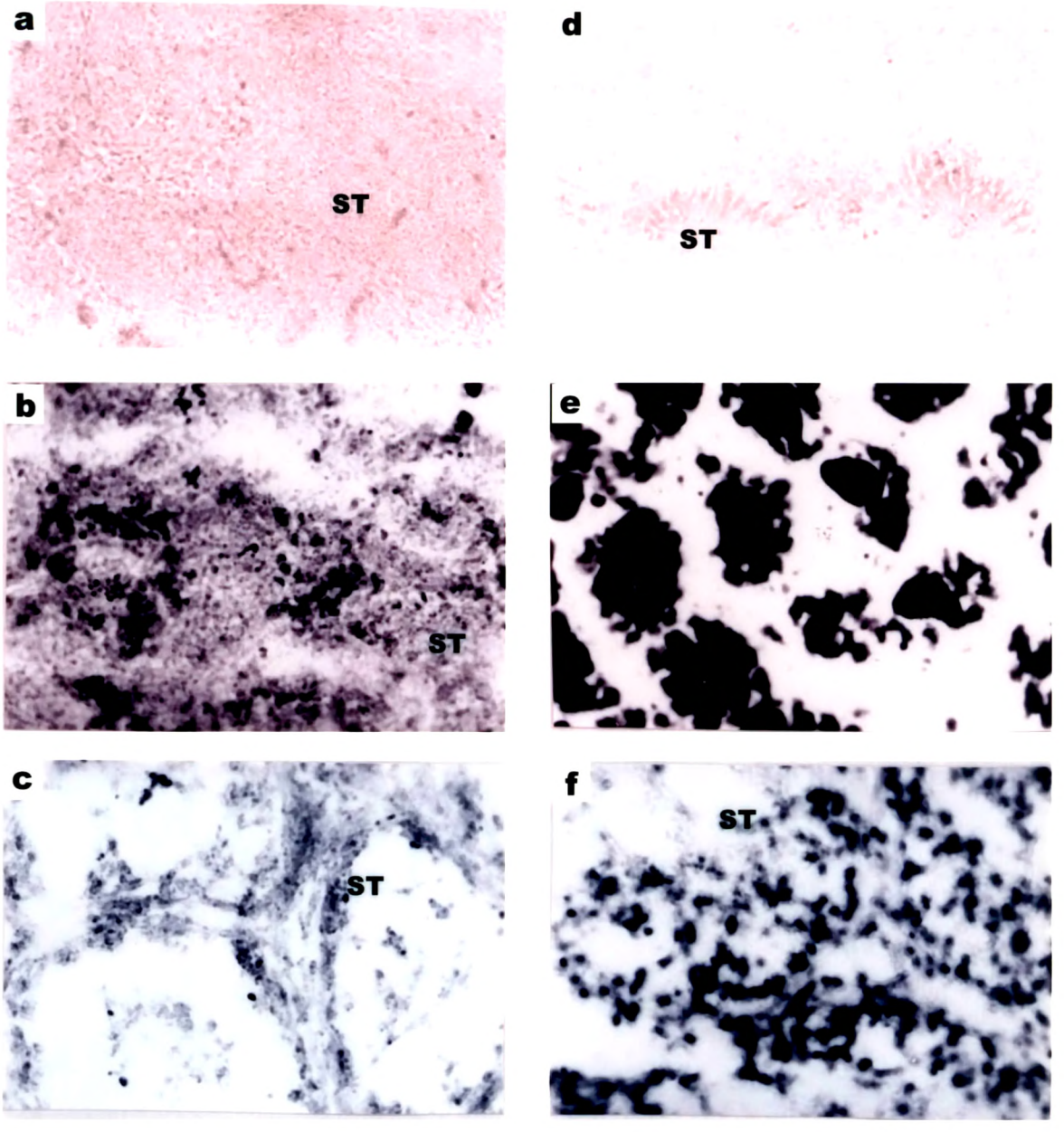


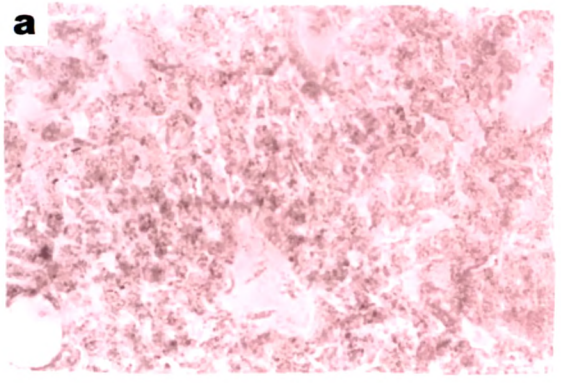
Plate LIV

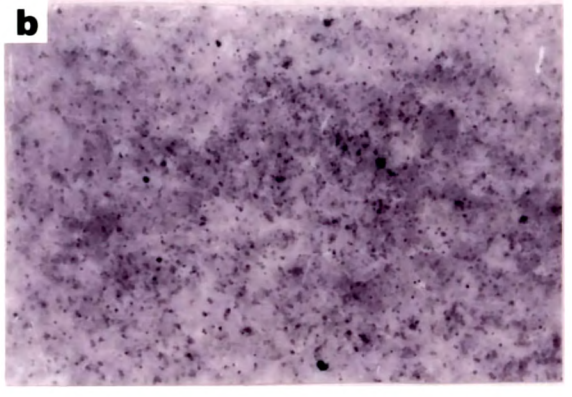
Histochemical localization of lipids in **liver** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

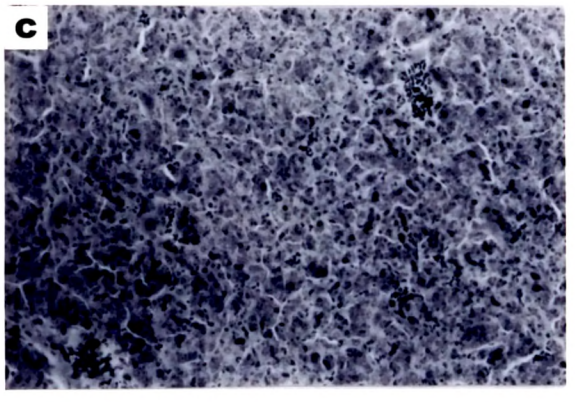
**- Non-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

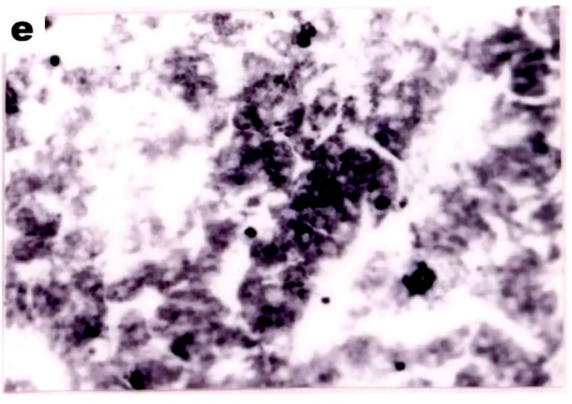
# PLATE **LIV**







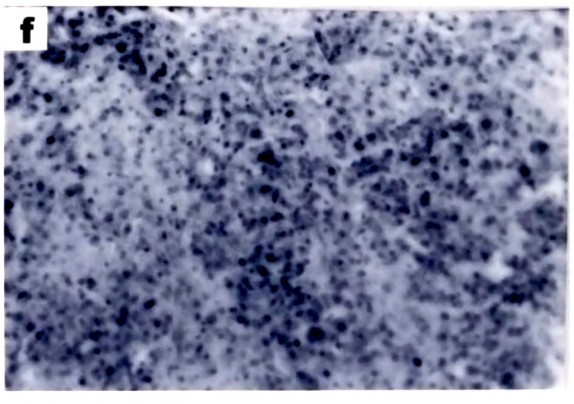



Plate LV

Histochemical localization of lipids in **intestine** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Non-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
EV : Epithelium of villi ; IG : Intestinal Glands

# PLATE **LV**

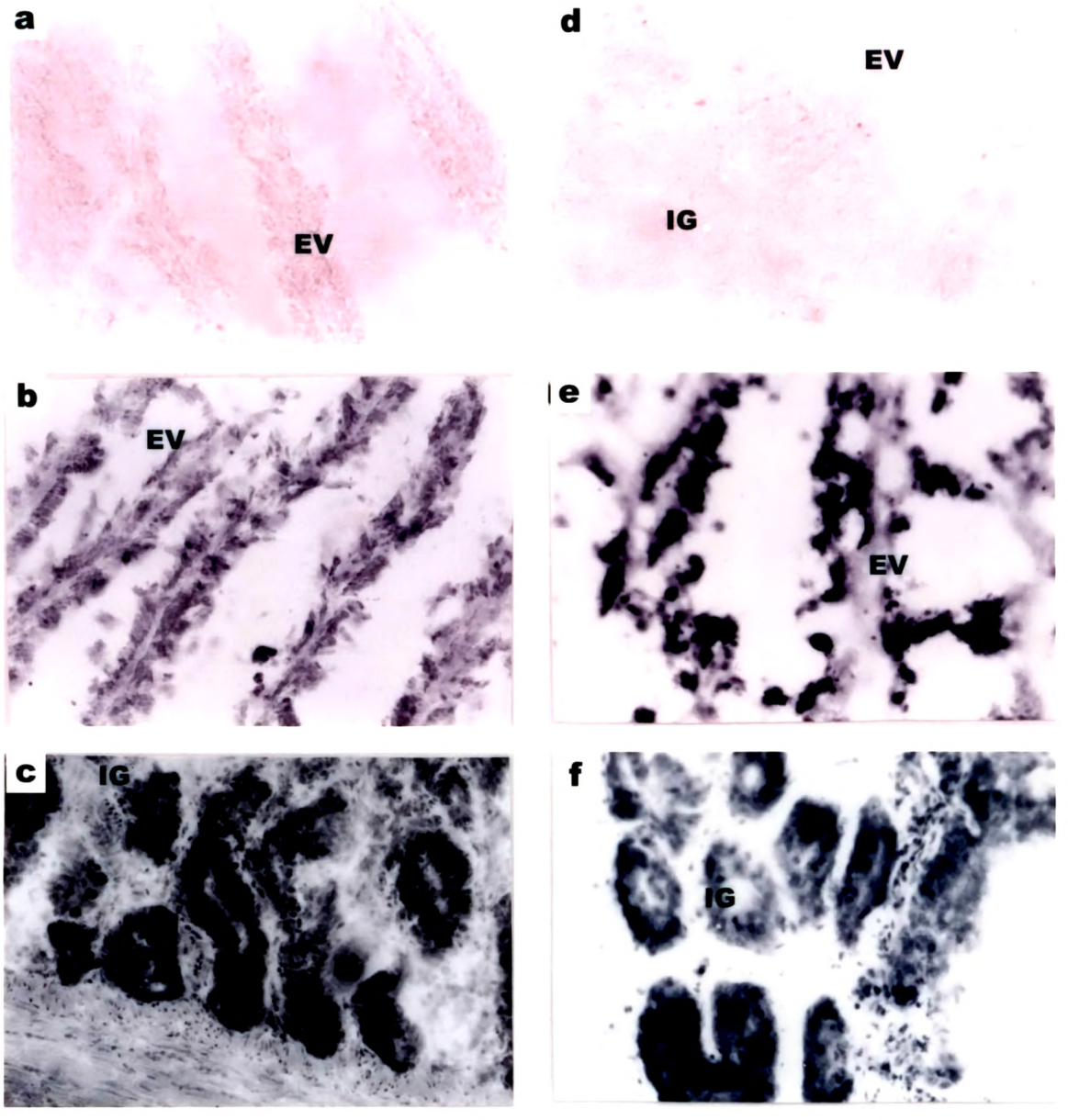


Plate LVI

Histochemical localization of lipids in **kidney** of Bank Myna, *Acridotheres ginginianus*, and Brahminy Myna, *Sturnus pagodarum*.

**- Non-Breeding phase –**

| **Bank Myna ♂** | | **Brahminy Myna ♂** | |
|---|---|---|---|
| a. Neutral lipids | (500X) | d. Neutral lipids | (500X) |
| b. Total lipids | (800X) | e. Total lipids | (800X) |
| c. Phospholipids | (800X) | f. Phospholipids | (500X) |

Abbreviation :
NT : Nephric Tissue ; G : Glomerulus

# PLATE **LVI**